

MARTA GUIDOTTI

THE VISUAL AND TYPOGRAPHIC DIMENSION OF LANGUAGE

ANALYSIS AND CLUSTERING OF LANGUAGES,
BASED ON LANGUAGE DESIGN FEATURES

WRITTEN WORDS:
FROM GRAPHEMATIC FORMS TO MEANING

15TH AWLL INTERNATIONAL WORKSHOP ON WRITING SYSTEMS AND LITERACY
29-31 OCTOBER 2025,
ITALIAN NATIONAL RESEARCH COUNCIL (CNR),
INSTITUTE FOR COMPUTATIONAL LINGUISTICS "ANTONIO ZAMPOLLI"
PISA, ITALY

READSEARCH



fwo

⇒ HOW LANGUAGE DIVERSITY IMPACTS LEGIBILITY?

MARTA GUIDOTTI
(PHD)

SUPERVISOR: ANN BESSEMANS
CO-SUP.: ANN DOOMS

READSEARCH



fwo

HOW

UNIVERSITY
ABILITY?

READSEARCH
HASSELT, BELGIUM

LEGIBILITY EXPERIMENTS
DATA-DRIVEN DESIGN
PRACTICAL LEGIBILITY RESEARCH
MICRO-MACRO TYPOGRAPHY

MARTA GUIDOTTI
(PHD)

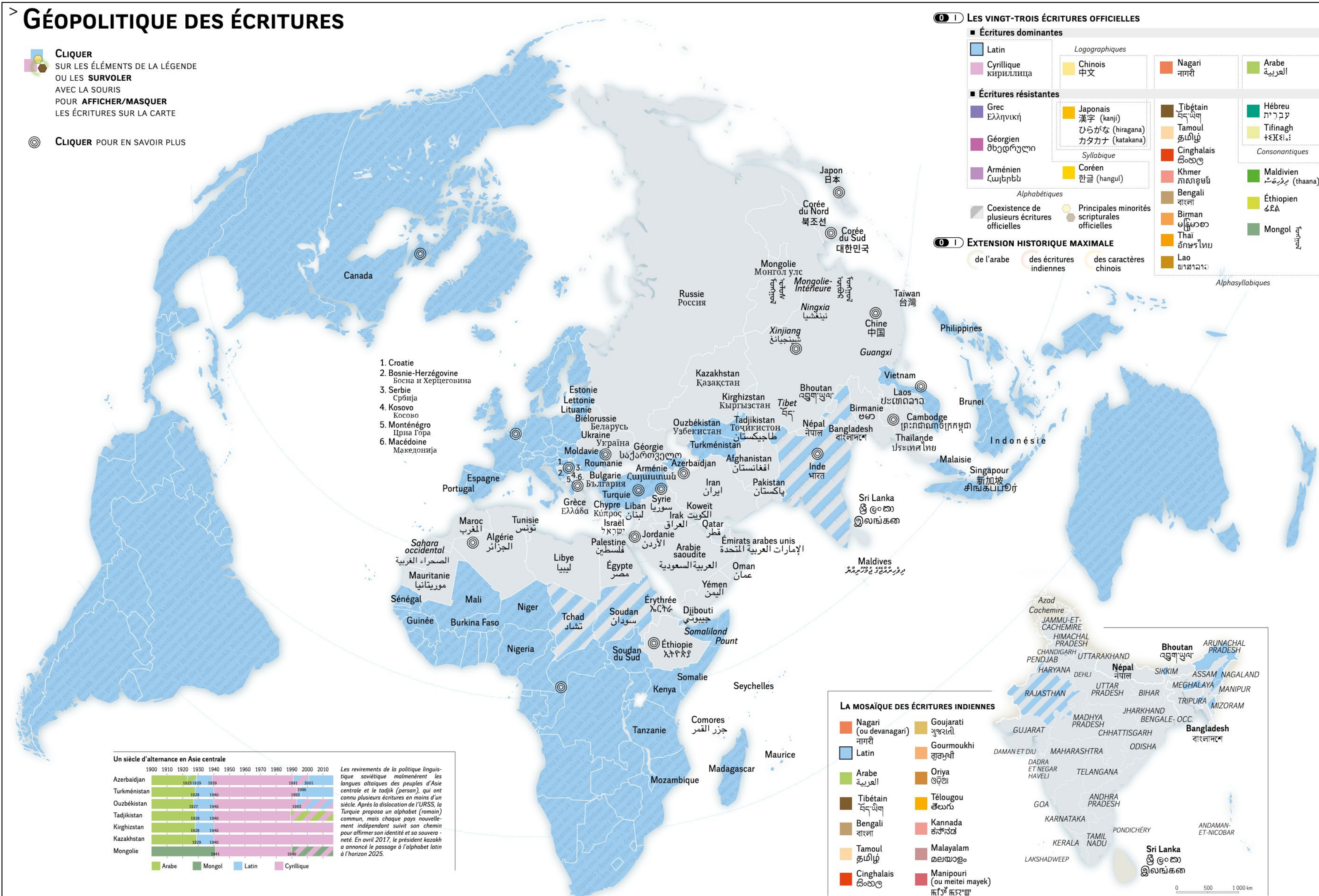
SUPERVISOR: ANN BESSEMANS
CO-SUP.: ANN DOOMS

READSEARCH



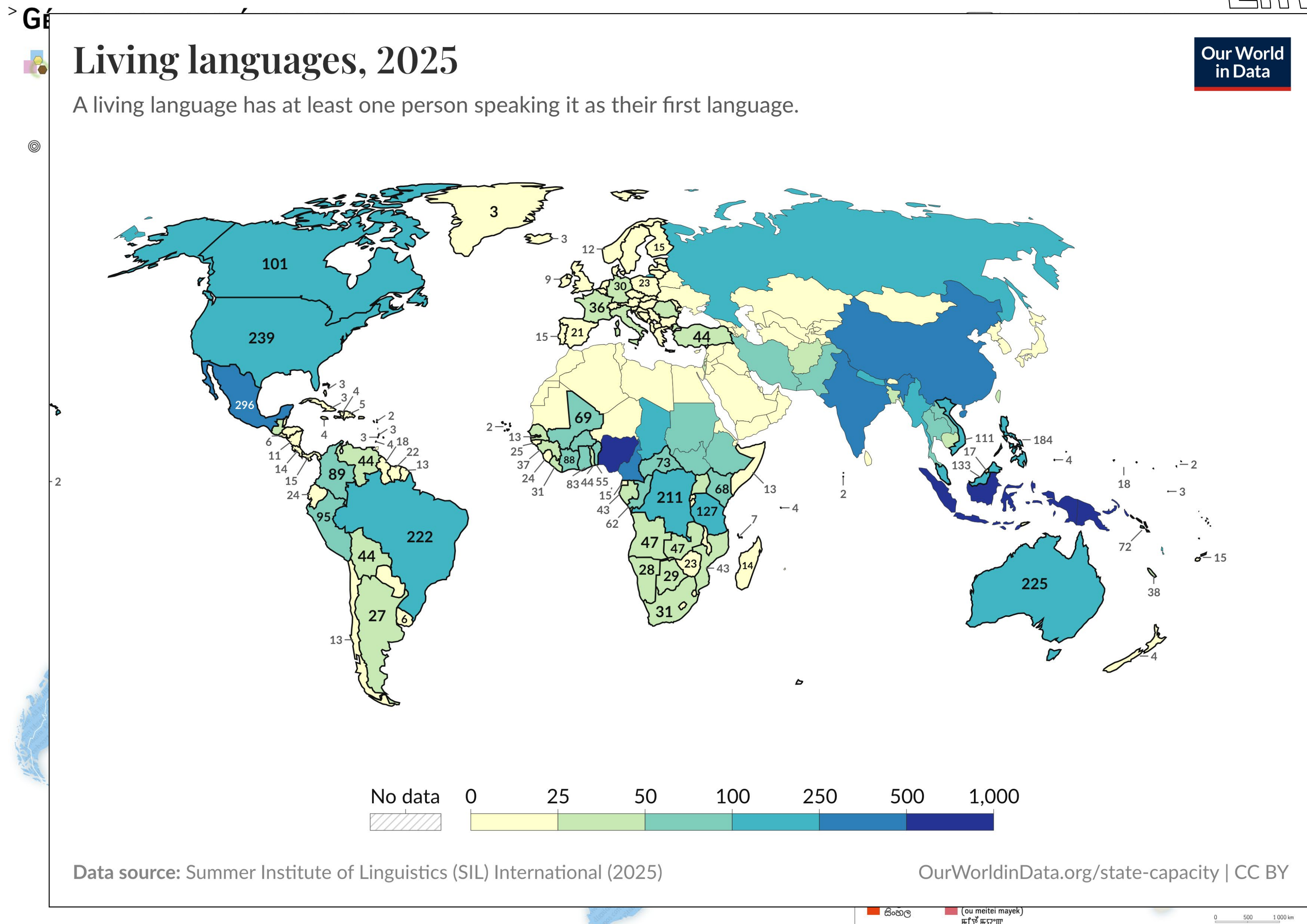
LATIN SCRIPT LANGUAGES

Le Monde diplomatique. “Géopolitique des écritures.” August 1, 2017. <https://www.monde-diplomatique.fr/cartes/ecritures>.



ONE SCRIPT, MANY LANGUAGES

LATIN SCRIPT LANGUAGES



ONE SCRIPT, MANY LANGUAGES

Our World

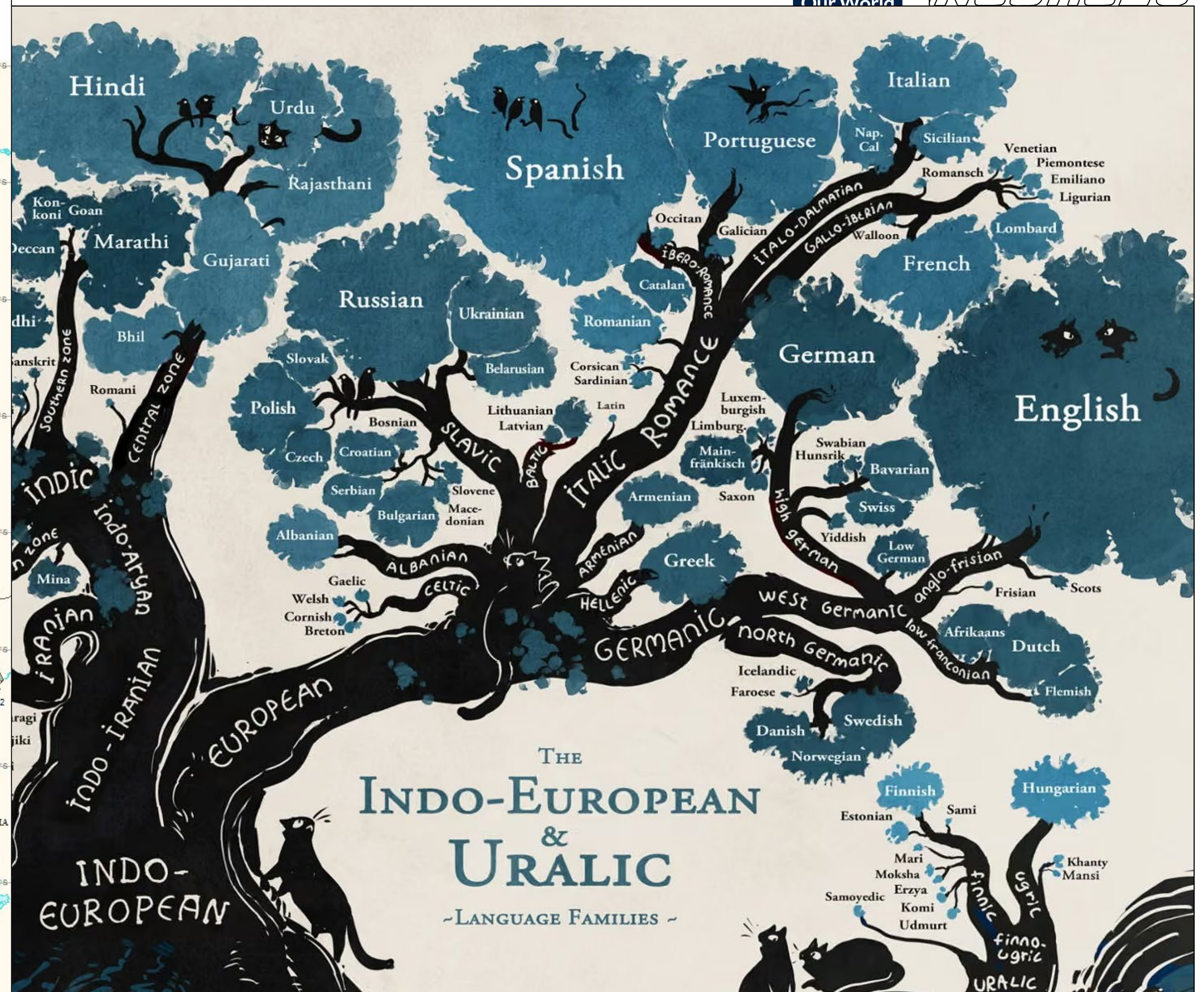


A living language



ONE SCRIPT, MANY LANGUAGES

Our World



LANGUAGE DIVERSITY IN TYPESETTING

STANDARD TYPESETTING

ENGLISH

n loves correction, but
good things, but the truth
open wide one's lip
oul is amply satisfied
is grace. Virtue guar
etends to be rich, yet
serve as ransom for
out the lamp of the v

STANDARD TYPESETTING

HUNGARIAN

és, a bölcsek nyelve
sem az. Csalárdság
im. Nem éri az igazsá
ajkat, de akik igazsá
pedig kérkedik bol
gódik szívében, az l
a bűnösöket pedig t
a kincse az emberne

LETTERS AND WORDS AS LANGUAGE DESIGN FEATURE
SHAPING BLACK AND WHITE IN TEXT

The visual/typographic dimension of languages.
Designing the black/white stripe pattern in text.

LANGUAGE DIVERSITY
IN TYPESETTING

STANDARD TYPESETTING

English

...n loves correcti
...od things, but th
...open wide one's lip
...oul is amply satisfie
...isgrace. Virtue guar
...tends to be rich, ye
...serve as ransom for
...ut the lamp of the v

life

STANDARD TYPESETTING

Hungarian

...és, a bölcsek ny
...sem az. Csalárdsa
...m. Nem éri az igaza
...ajkat, de akik igazar
...pedig kérkedik bolo
...ódik szívében, az
...a búnsöket, pedig t
...a kincse az emberre

é
elánmää

LETTERS / DIACRITICS

WORD LENGTH

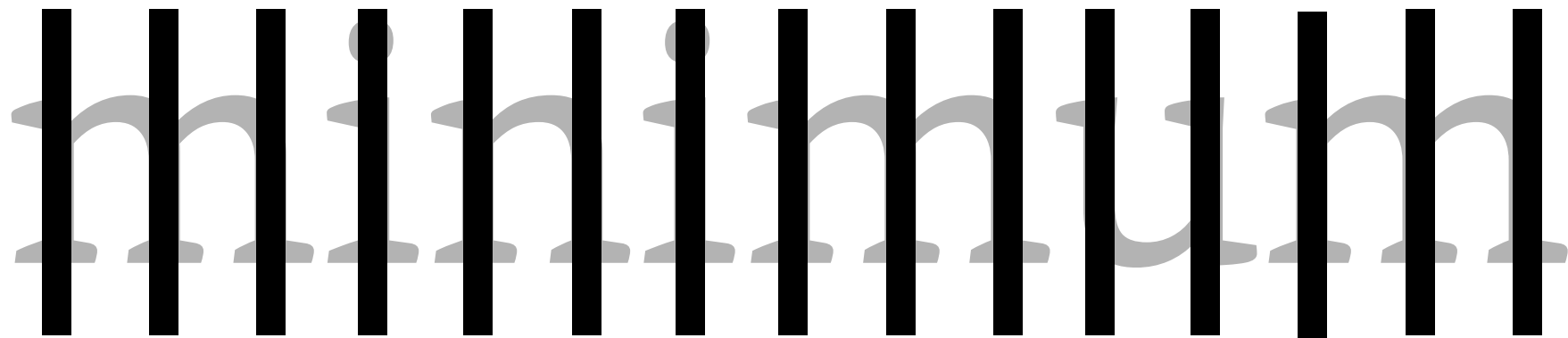
LETTERS AND WORDS AS LANGUAGE DESIGN FEATURE
SHAPING BLACK AND WHITE IN TEXT

The visual/typographic dimension of languages.
Designing the black/white stripe pattern in text.

LEGIBILITY IS RHYTHM ➡ VISUAL COMFORT

VERTICAL RHYTHM OF A TYPEFACE

minimum



HORIZONTAL RHYTHM OF TEXT

n loves correction, b
od things, but the tr
open wide one's lip
oul is amply satisfie
is grace. Virtue guar
etends to be rich, ye
serve as ransom fo
out the lamp of the v

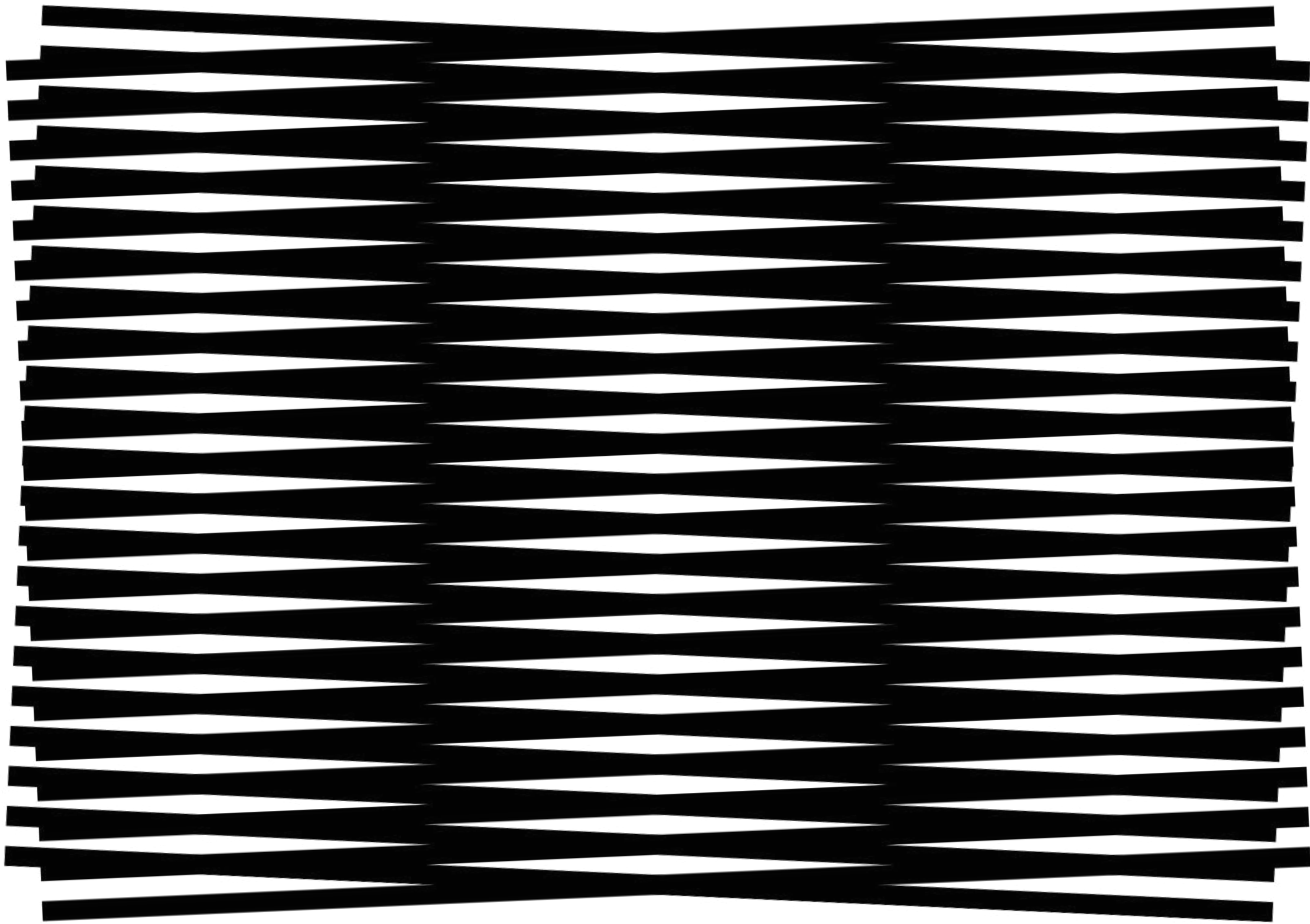
BLACK AND WHITE (RATIO) STRIPE PATTERN

Legibility is measured as
rhythm and visual dis/comfort

RHYTHM
COMFORT

VISUAL DISCOMFORT
IN STRIPE PATTERNS
A. J. Wilkins, Visual stres (1995)

VISUAL STRESS,
MIGRAINE,
EYE FATIGUE
A. J. Wilkins, Visual stres (1995)



V

I

I

BLACK AND
STRIPE I

HORIZONTAL RHYTHM OF TEXT

ENGLISH

n loves correction,
good things, but the tongue
open wide one's lip
tongue is amply satisfied

ENGLISH

n loves correction, but
good things, but the tongue
open wide one's lip
tongue is amply satisfied



LETTER POSITION

HUNGARIAN

ajkat, de akik igazán
pedig kérkedik bolond
gódik szívében, az
a bűnösöket pedig t

HUNGARIAN

ajkat, de akik igazán
pedig kérkedik bolond
gódik szívében, az
a bűnösöket pedig t



TEXT AS A
STRIPE PATTERN

HOW LANGUAGES
SHAPE THE RHYTHM

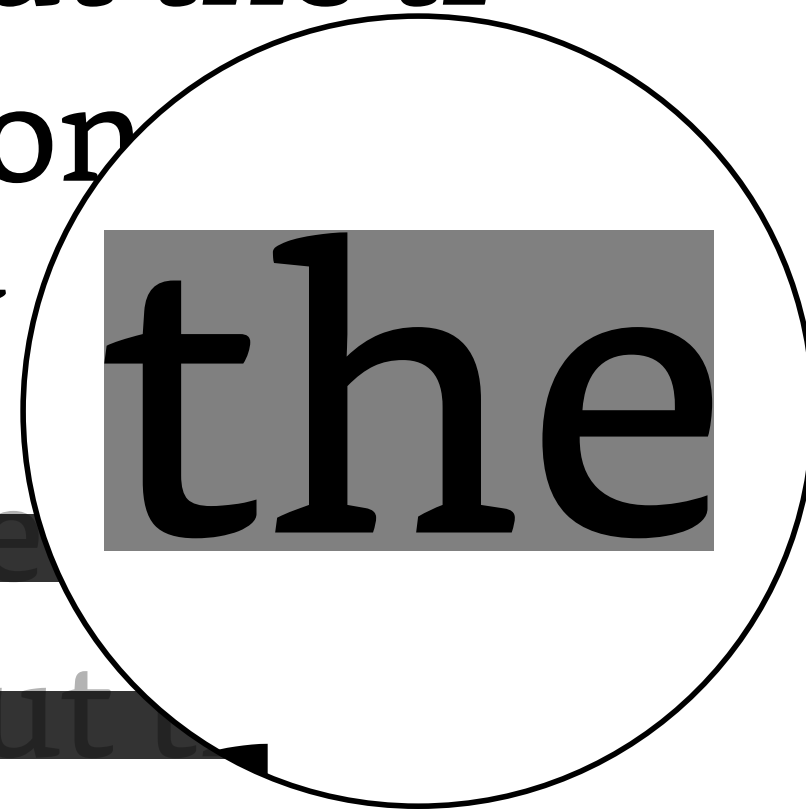
HORIZONTAL RHYTHM OF TEXT

ENGLISH

n loves correction, but the truth
is open wide on
one's lip is amply satisfied

ENGLISH

n loves correction,
but the truth
is open wide one's lip
is amply satisfied



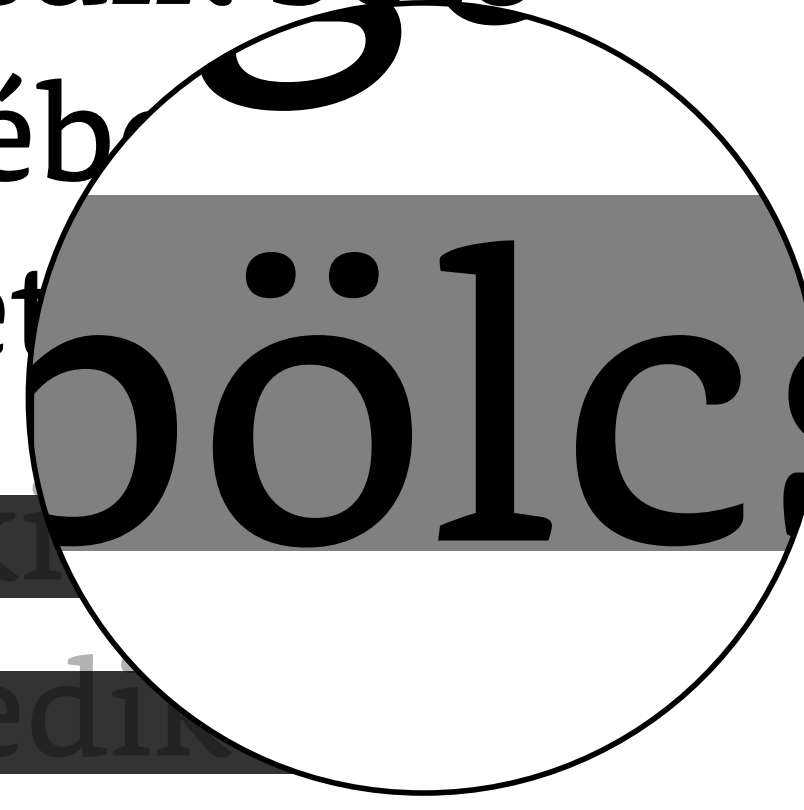
WORD LENGTH

HUNGARIAN

ajkat, de akik igazán
pedig kérkedik boldog
gódik szívében, az
a bűnösöket pedig t

HUNGARIAN

ajkat, de akik
pedig kérkedik
gódik szívében, az
a bűnösöket pedig t



TEXT AS A
STRIPE PATTERN

HOW LANGUAGES
SHAPE THE RHYTHM

VERTICAL RHYTHM OF TEXT

ENGLISH
minimum
minimum

LETTERS STROKES

TEXT AS A 
STRIPE PATTERN

HUNGARIAN
lépésére
lépésére

HOW LANGUAGES
SHAPE THE RHYTHM

TEXT AS A STRIPE PATTERN

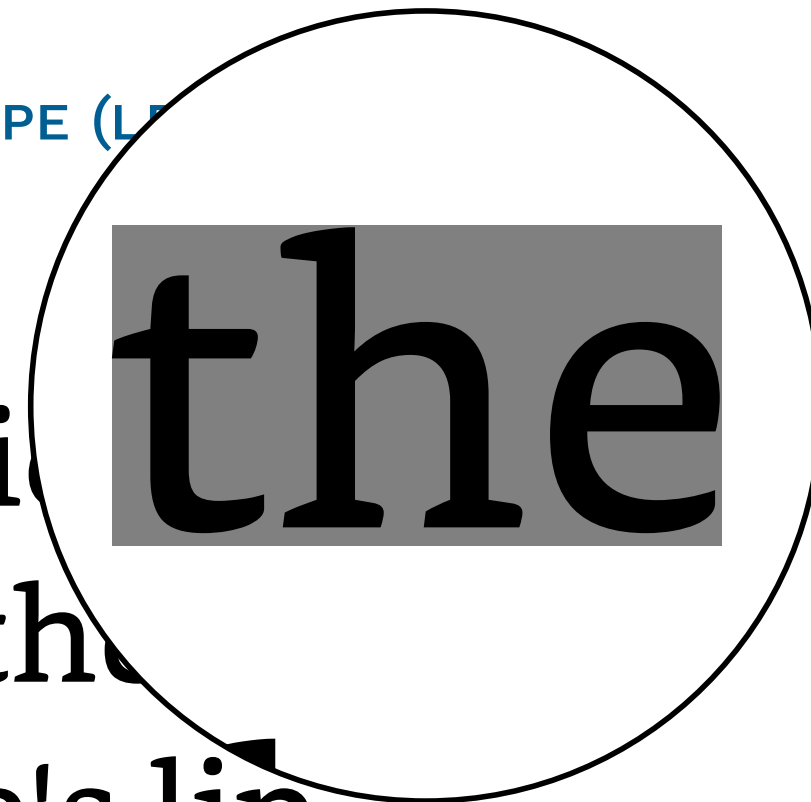
VERTICAL RHYTHM OF A TYPEFACE

LETTER STROKE(S), LETTERS SHAPE (LETTERS)

LETTERS STROKES
SHAPE

ENGLISH

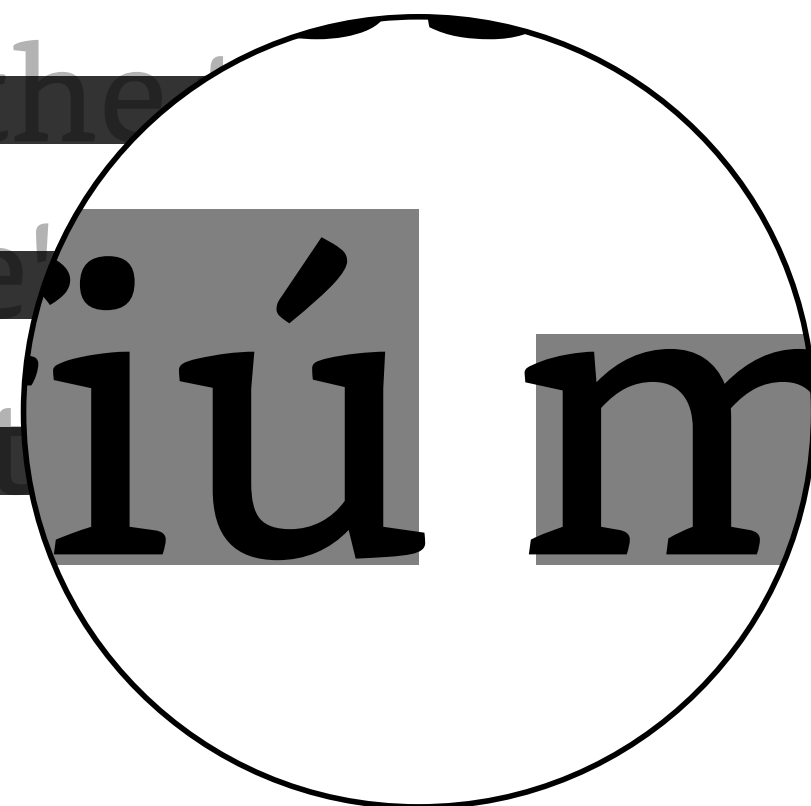
n loves correction,
od things, but the
open wide one's lip
oul is amply satisfie



LETTER/WORD SPACE

ENGLISH

n loves correction,
od things, but the
open wide one's
oul is amply sat



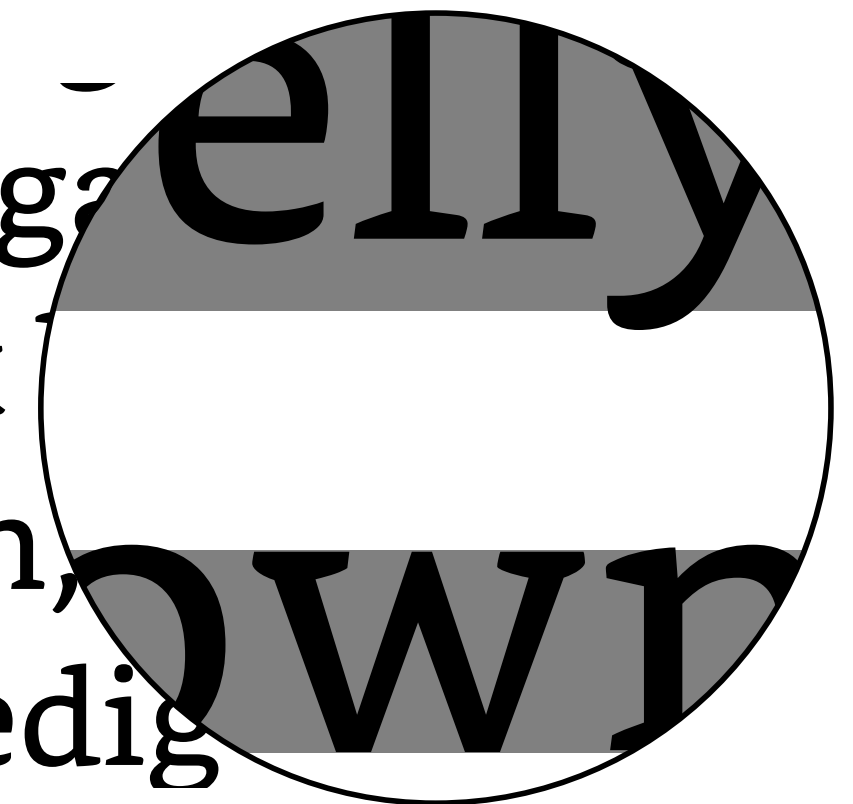
HOW LANGUAGES SHAPE THE RHYTHM

HORIZONTAL RHYTHM OF TEXT

TOP/BOTTOM LETTERS, COMPOSED/SINGLE

HUNGARIAN

ajkat, de akik igaz
pedig kérkedik
gódik szívében,
a bűnösöket pedig



LETTERS POSITION

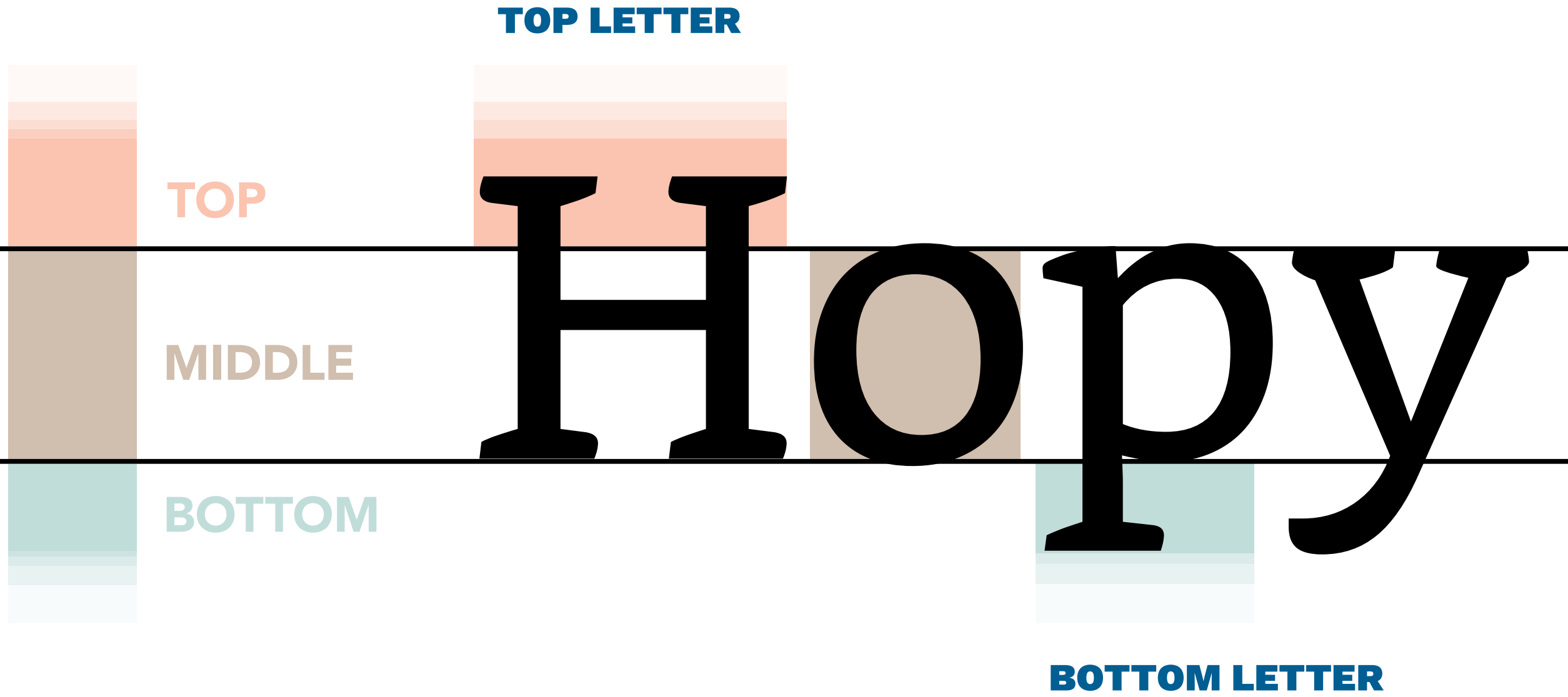
HUNGARIAN

ajkat, de akik igaz
pedig kérkedik bol
gódik szívében
a bűnösöket pe



THE VISUAL AND TYPOGRAPHIC DIMENSION OF LANGUAGE
PhD supervisor: Ann Bessemans, co-sup.: Ann Dooms FWO, Hasselt University, PXL-MAD School of Arts, READSEARCH, DSI
Marta Guidotti
29/10/2025
15th AWLL - Pisa, IT

HORIZONTAL RHYTHM OF TEXT



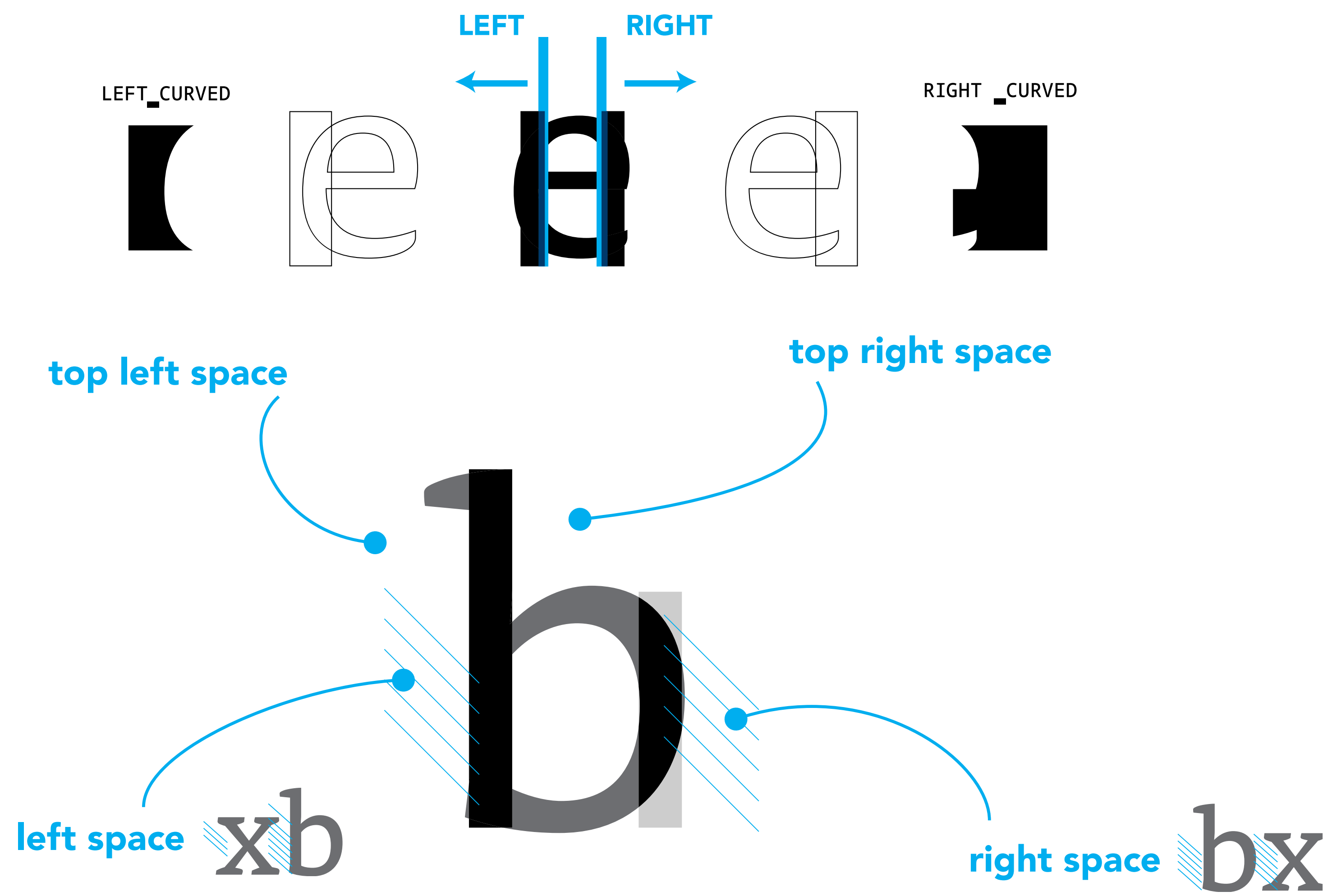
**DECONSTRUCTION
SYSTEM** ←

és, a bölcsek nyelve
sem az. Csalárdság
m. Nem éri az igaz
ajkat, de akik igaz
pedig kérkedik bolo
gódik szívében, az l
a bűnösöket pedig t
a kincse az emberne

**TOP- BOTTOM- LETTERS
OVER AND UNDER X-HEIGHT**

Deconstruction system based on type design practice

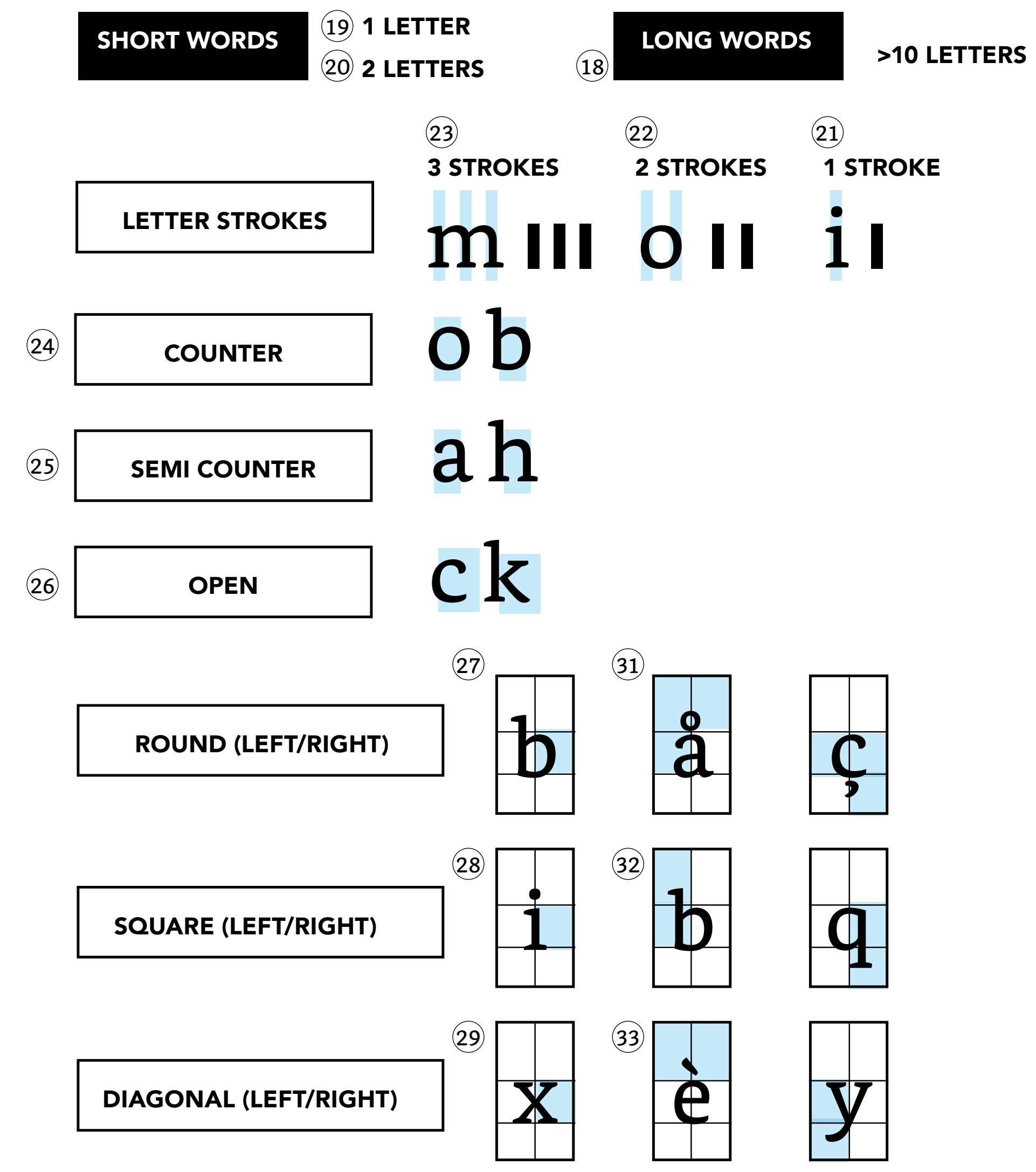
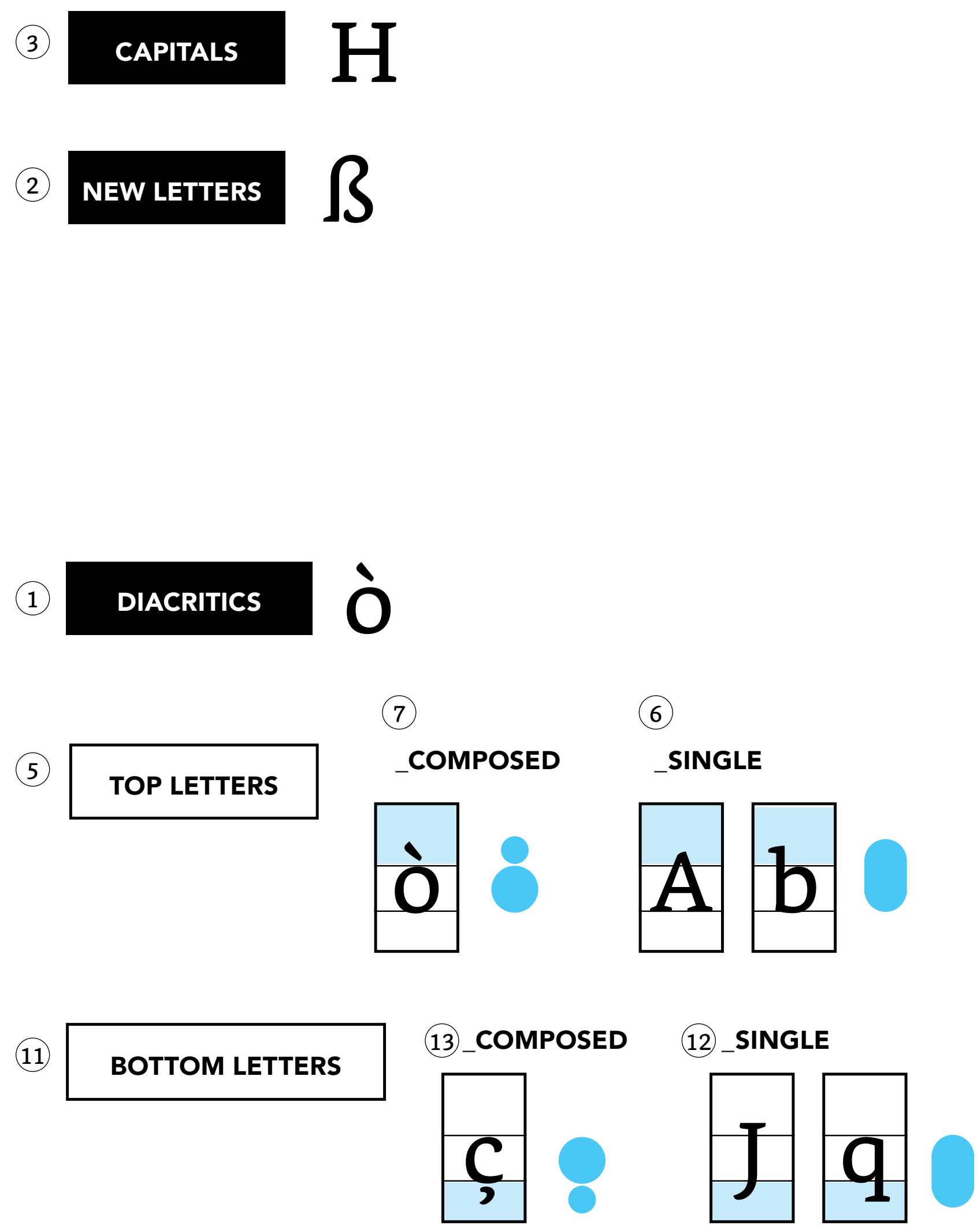
VERTICAL RHYTHM OF A TYPEFACE



VERTICAL RHYTHM:
HOW LETTER STROKES SHAPES THE L/R SPACE

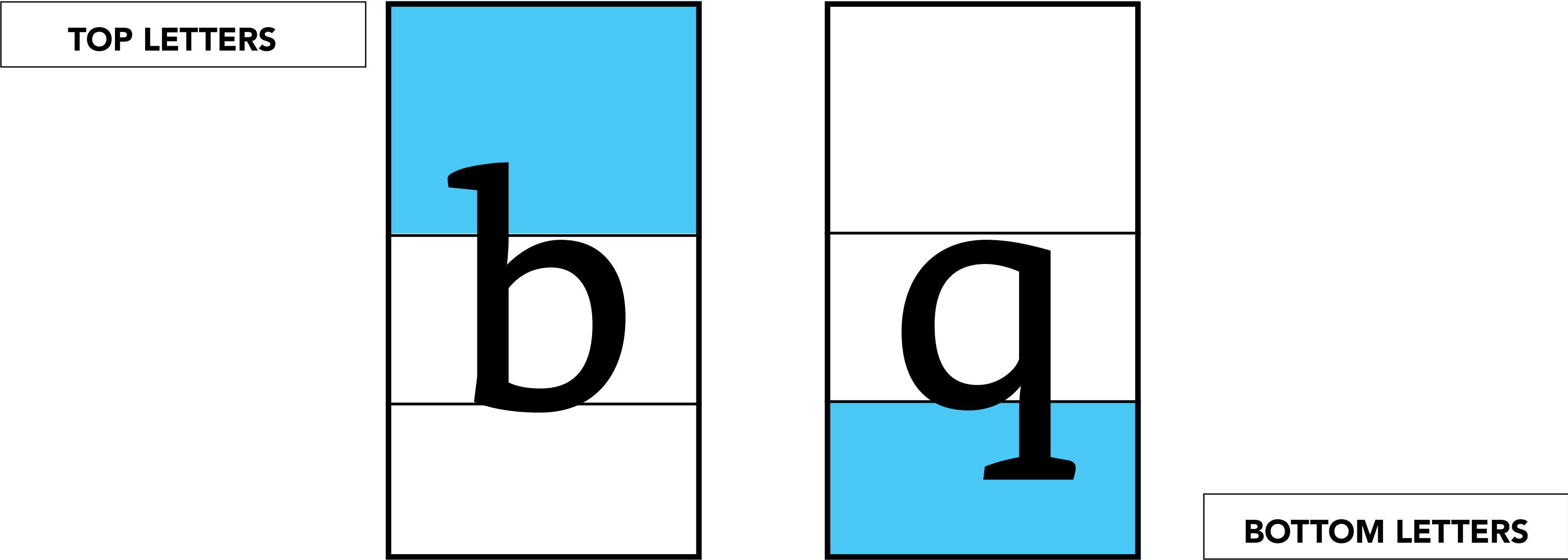
Deconstruction system based on type design practice

LANGUAGE DESIGN FEATURES



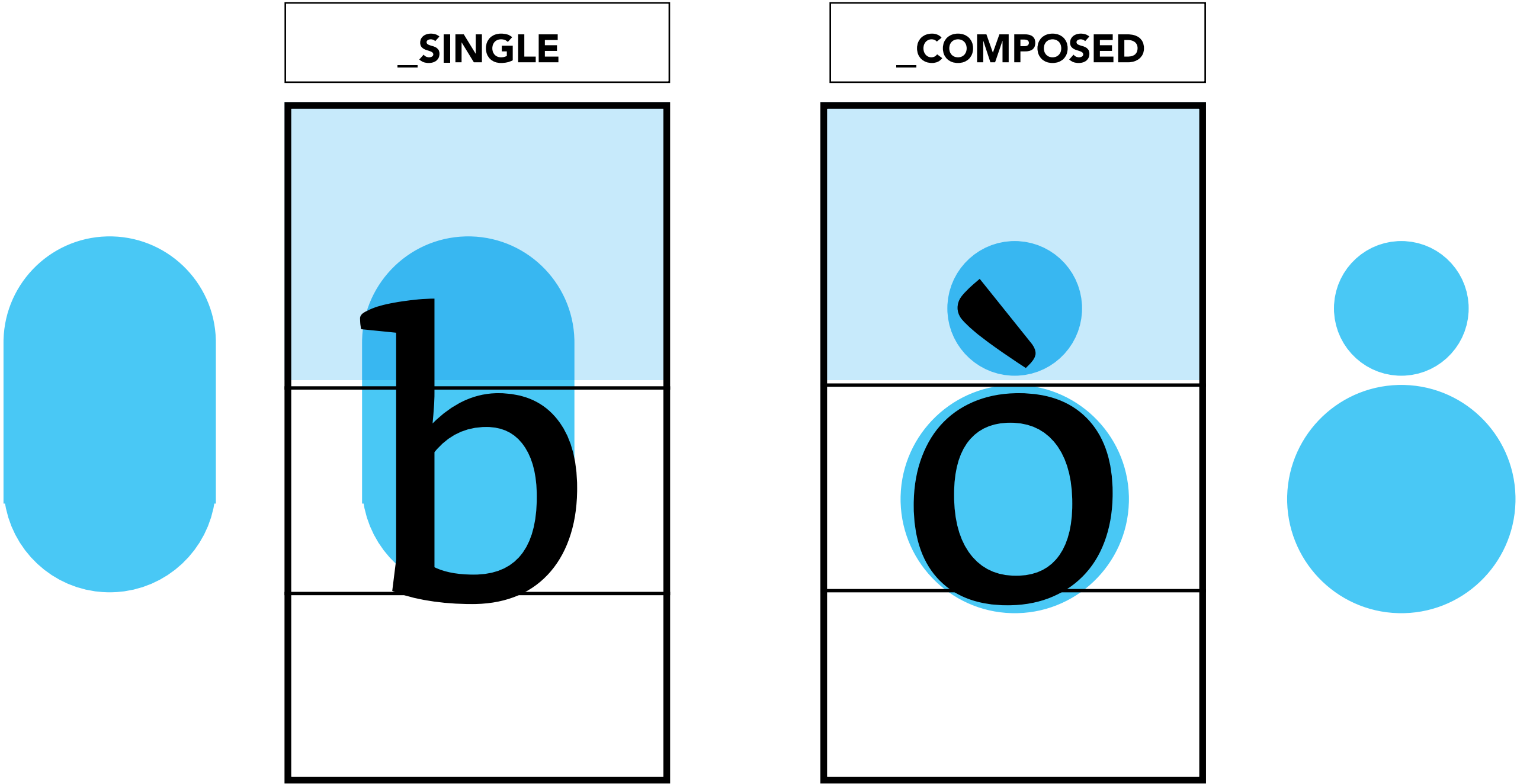
Selected in relation to
the horizontal and vertical rhythm

CATEGORIZATION ON
HOW LETTERS ARE SHAPING THE SPACE



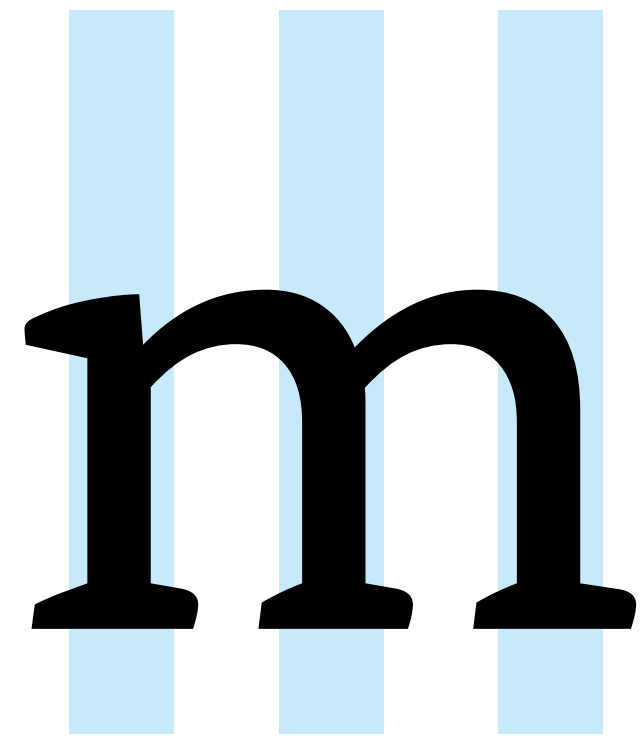
CATEGORIZATION ON
HOW LETTERS ARE SHAPING THE SPACE

Selected in relation to
the horizontal and vertical rhythm

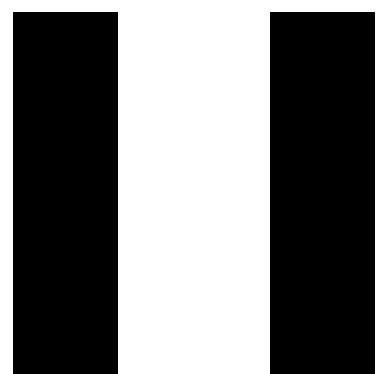
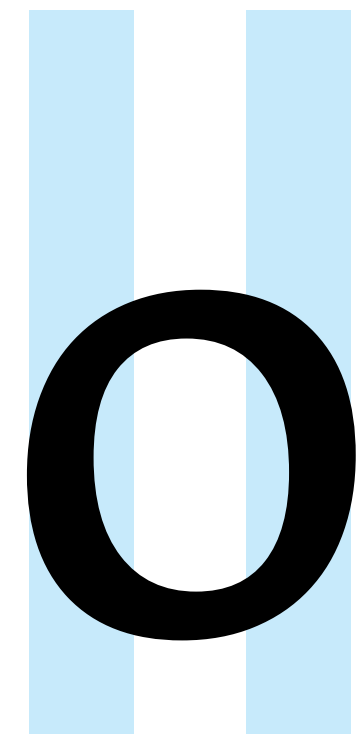


**CATEGORIZATION ON
HOW LETTERS ARE SHAPING THE SPACE**

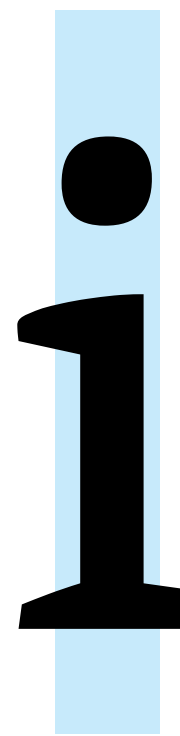
Selected in relation to
the horizontal and vertical rhythm



3 STROKES



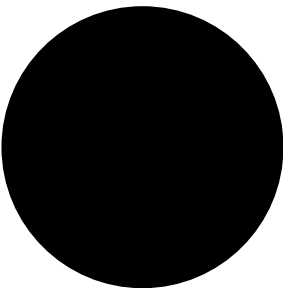
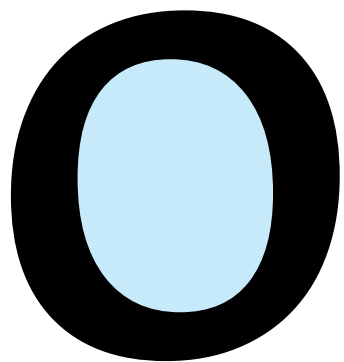
2 STROKES



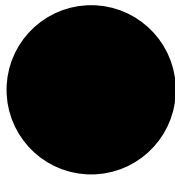
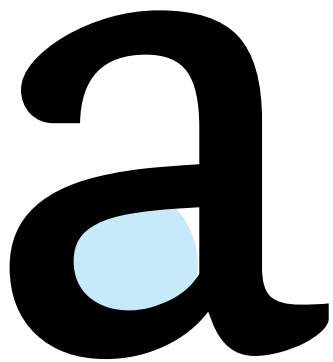
1 STROKE

CATEGORIZATION ON
HOW LETTERS ARE SHAPING THE SPACE

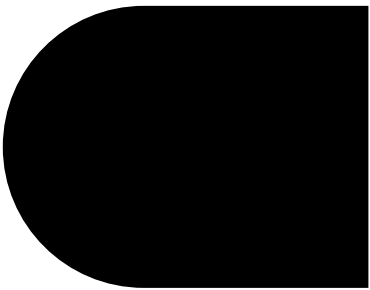
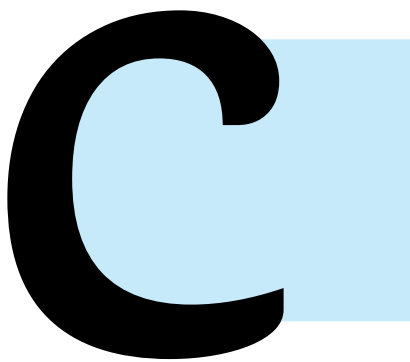
Selected in relation to
the horizontal and vertical rhythm



COUNTER



SEMICOUNTER



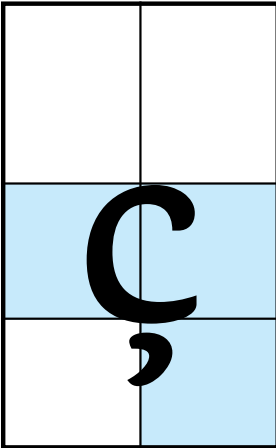
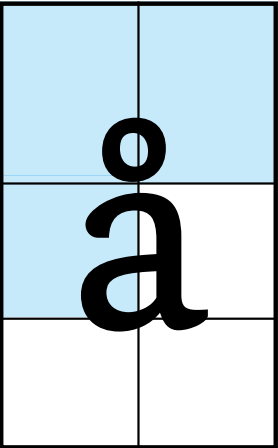
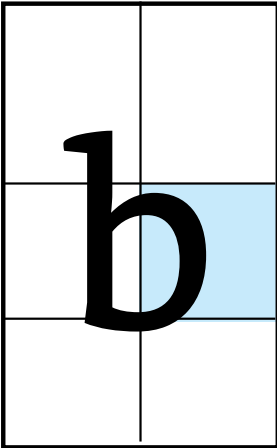
OPEN

CATEGORIZATION ON
HOW LETTERS ARE SHAPING THE SPACE

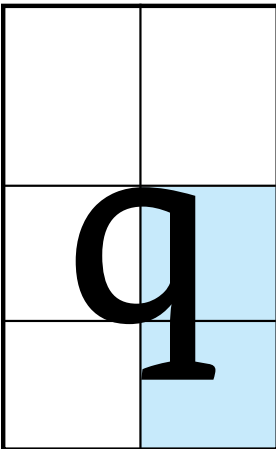
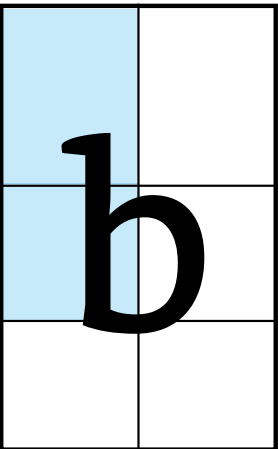
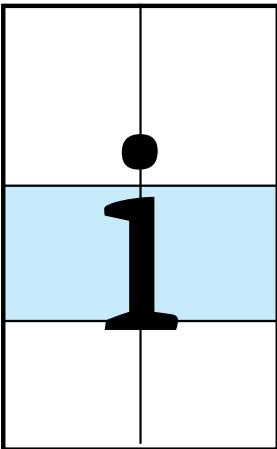
Selected in relation to
the horizontal and vertical rhythm

LANGUAGE DESIGN
FEATURES

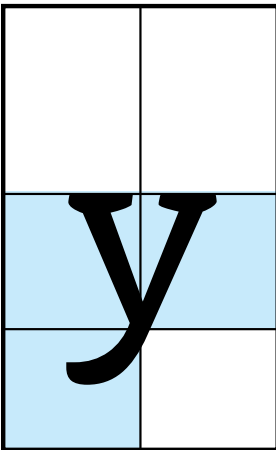
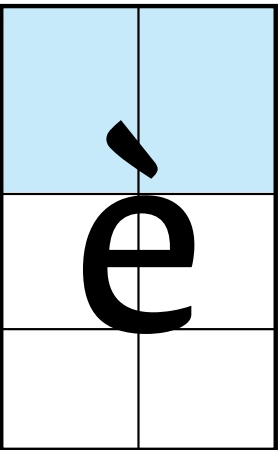
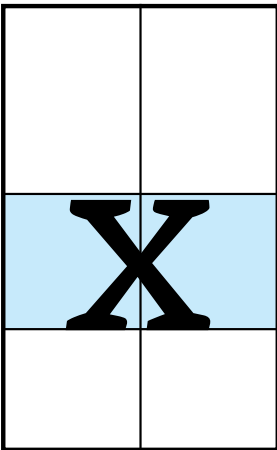
ROUND (LEFT/RIGHT)



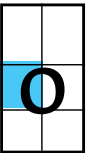
SQUARE (LEFT/RIGHT)



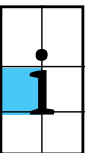
DIAGONAL (LEFT/RIGHT)



⑪ ROUND LEFT
*127 letters



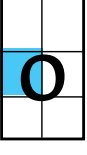
⑫ SQUARE LEFT
*227 letters



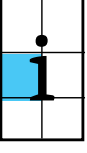
⑬ DIAGONAL LEFT
*70 letters



⑳ ROUND RIGHT
*143 letters



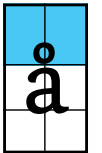
㉔ SQUARE RIGHT
*203 letters



㉙ DIAGONAL RIGHT
*79 letters



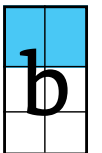
⑧ TOP_ROUND
*88 letters



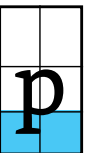
⑮ BOTTOM_ROUND
*37 letters



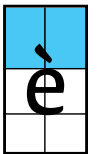
⑨ TOP_SQUARE
*104 letters



⑮ BOTTOM_SQUARE
*10 letters



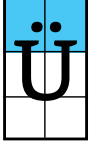
⑦ TOP_DIAGONAL
*97 letters



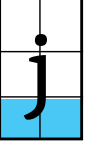
⑭ BOTTOM_DIAGONAL
*12 letters



⑩ TOP_SQUARE_ROUND
*11 letters



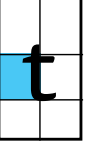
⑰ BOTTOM_SQUARE_ROUND
*7 letters



⑨⑩ SQUARE_ROUND RIGHT
*5 letters



②④ SQUARE_ROUND LEFT
*27 letters

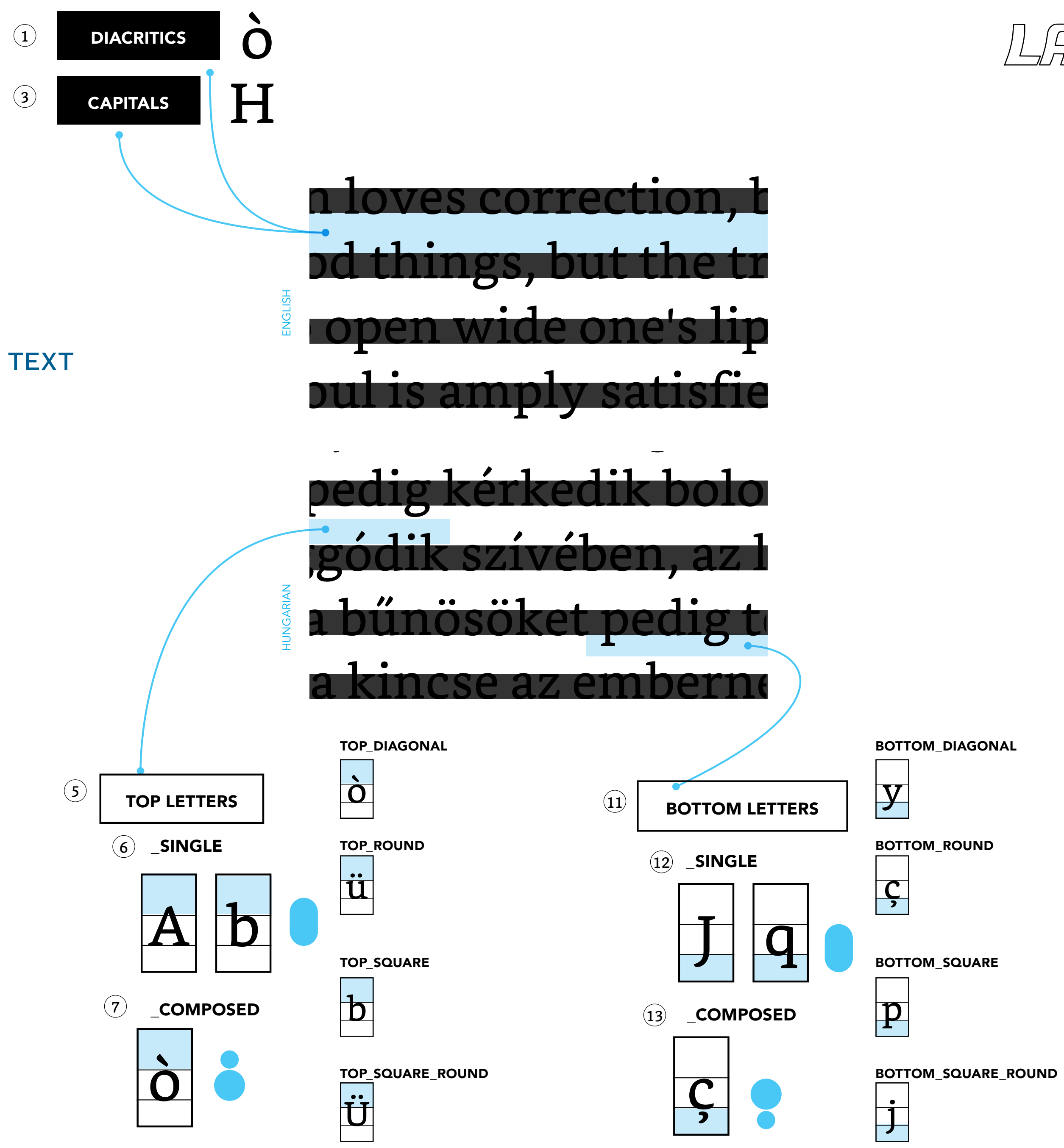


CATEGORIZATION ON
HOW LETTERS ARE SHAPING THE SPACE

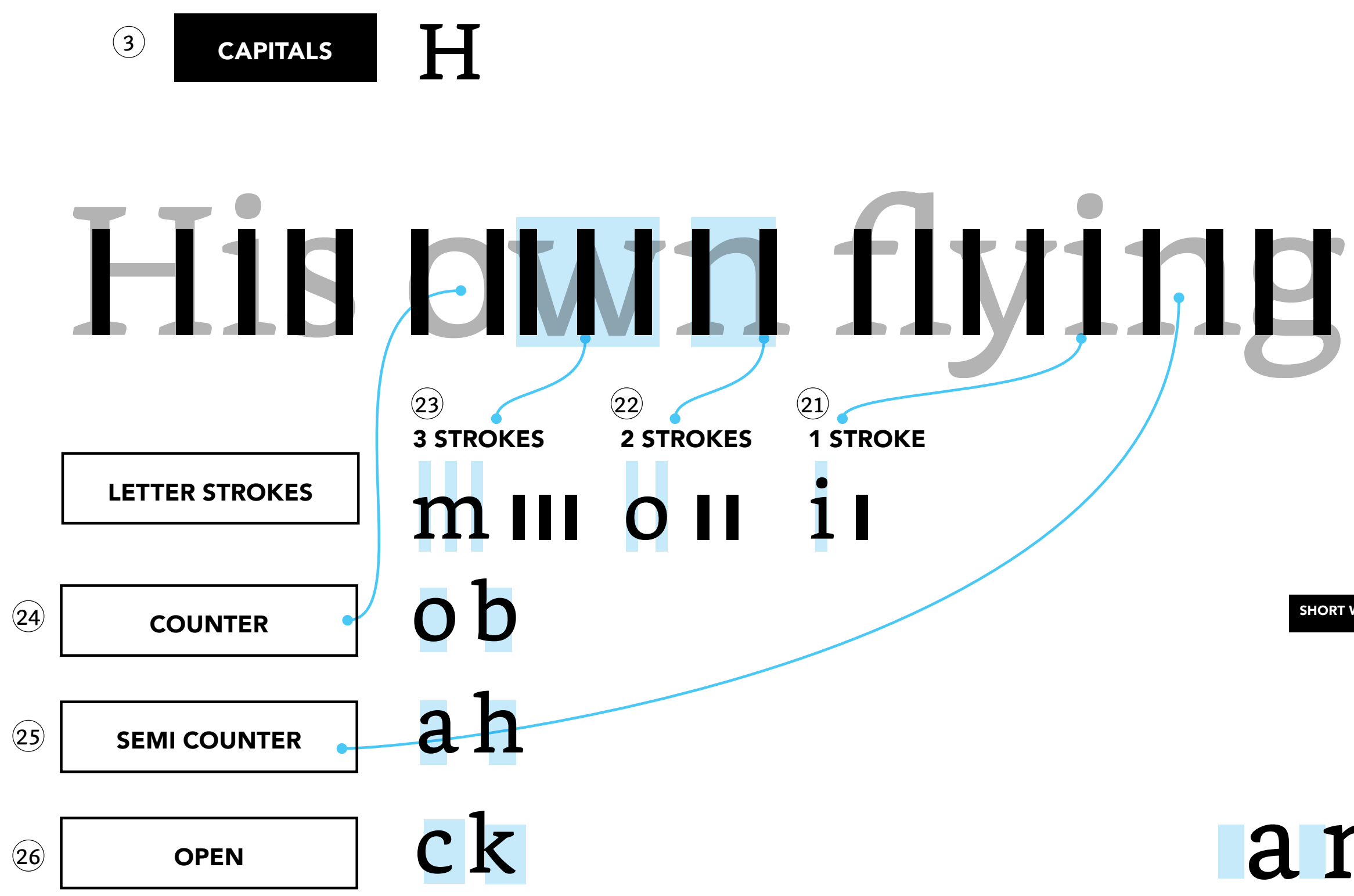
Selected in relation to
the horizontal and vertical rhythm

LANGUAGE DESIGN FEATURES

CONNECTION TO THE
HORIZONTAL RHYTHM OF TEXT



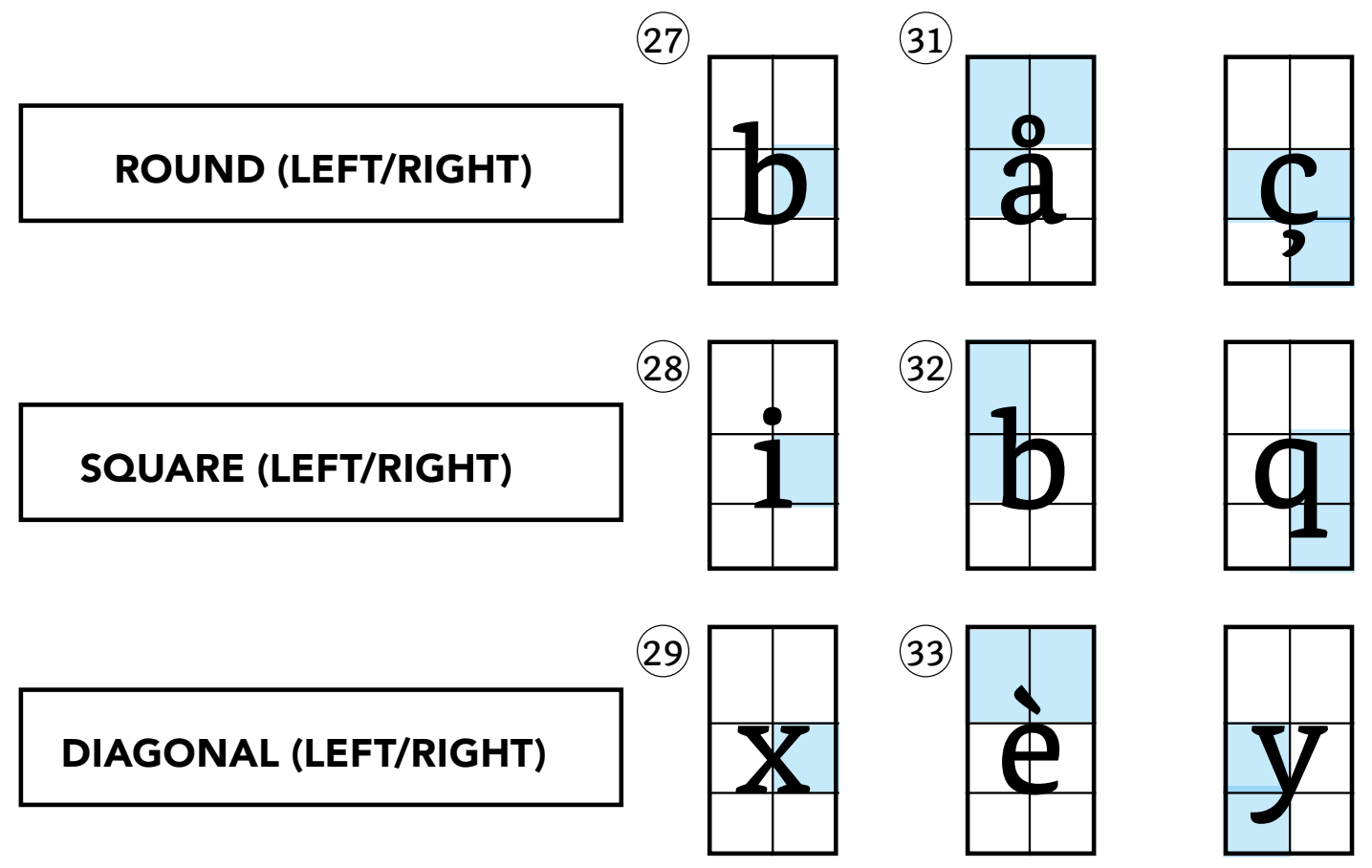
LANGUAGE DESIGN FEATURES



SHORT WORDS ①⑨ 1 LETTER ②⑩ 2 LETTER ①⑧ LONG WORDS >10 LETTERS

me is a mum
a minimalistical

CONNECTION TO THE
VERTICAL RHYTHM OF TEXT



TYPESETTING

English
n loves correction, but
od things, but the tr
open wide one's lip
oul is amply satisfie
is grace. Virtue guar
etends to be rich, ye

minimum

Hungarian
sem az. Csalárdtság v
m. Nem éri az igazsá
ajkat, de akik igazsá
pedig kérkedik bolo
gódik szívében, az l
a bűnösöket pedig t

lépniére

HORIZONTAL RHYTHM

LINE-SPACING

VERTICAL RHYTHM

WORD SPACING

LETTER SPACING

LANGUAGE SHAPES “BLACK”
TYPESETTING SHAPES “WHITE”

In defining the text pattern,
the counterpart to language (black) is typesetting (white).

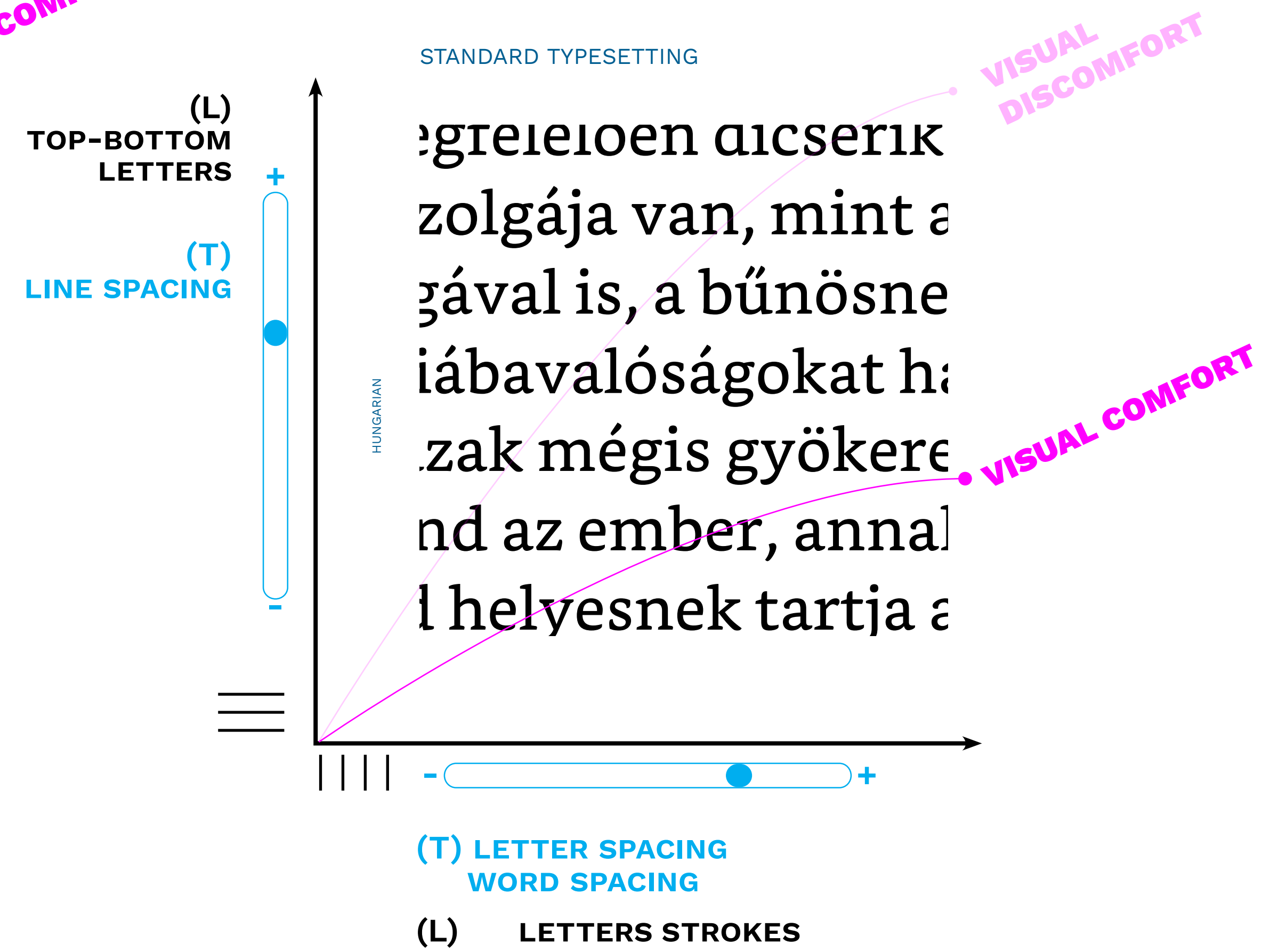
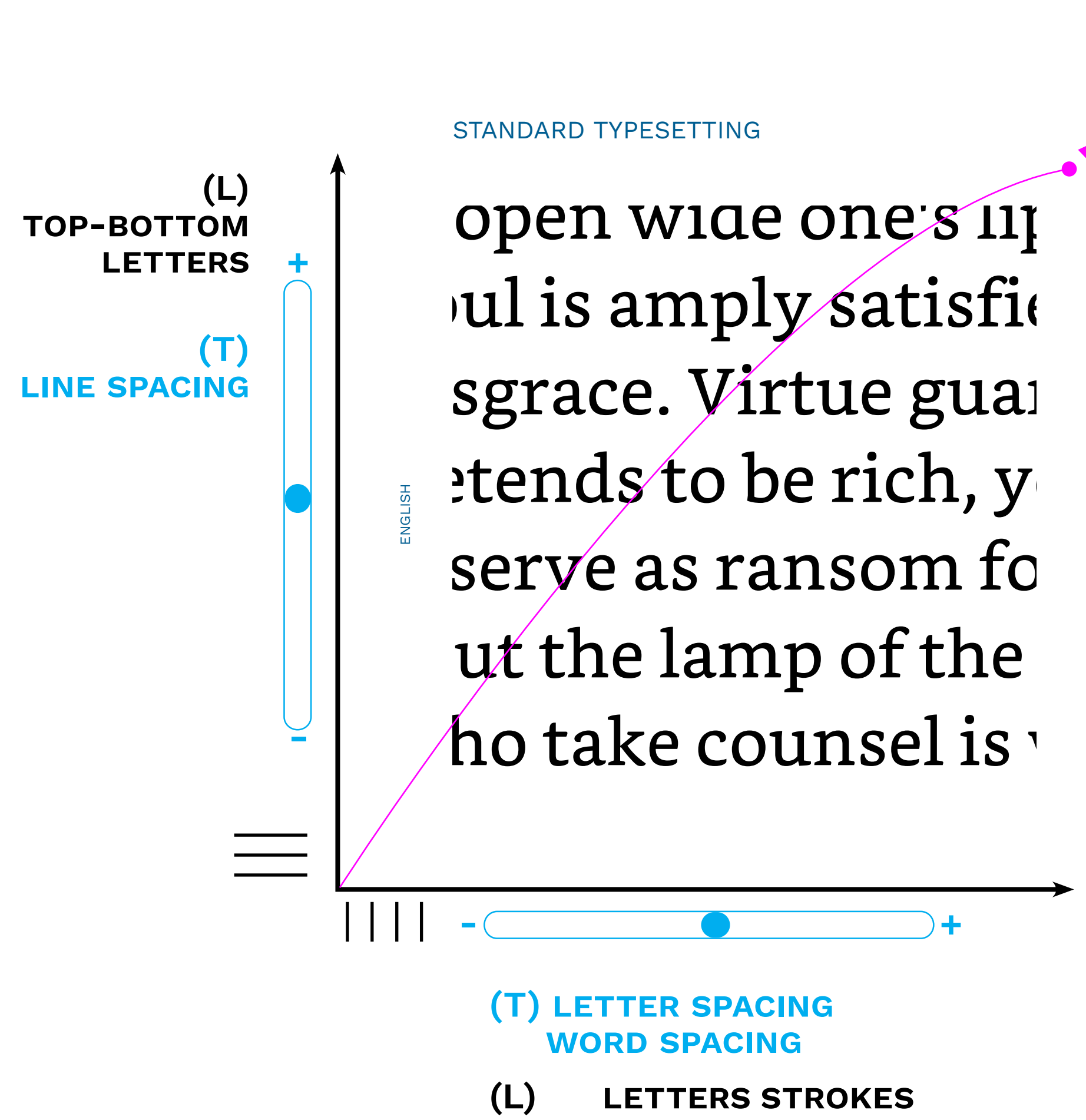
TESTING PHASE

CAN READERS PERCEIVE
LANGUAGE VISUAL DIVERSITY?

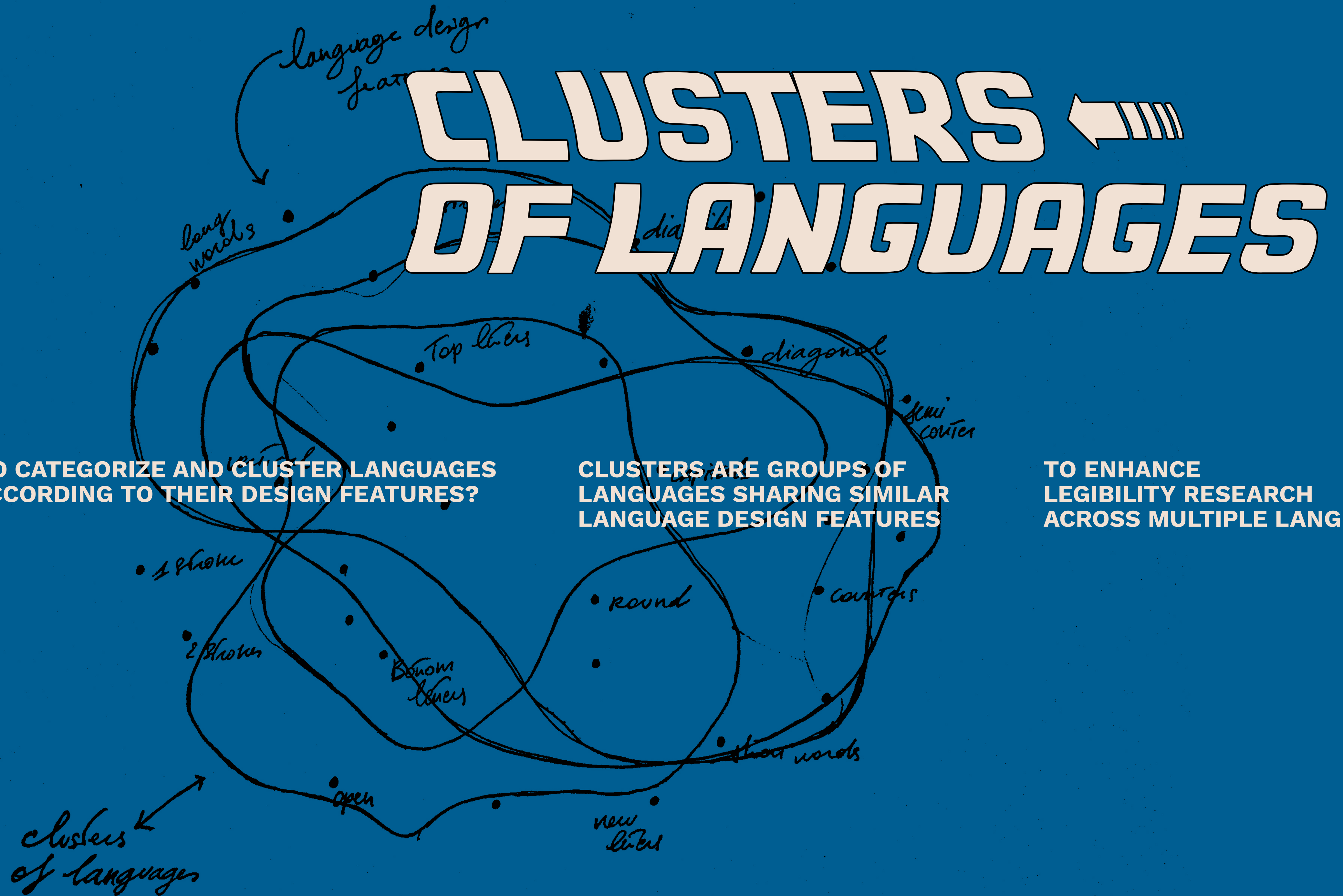
HOW TO OPTIMIZE TYPESETTING
TO REACH READING COMFORT?



(L) = LANGUAGE DESIGN FEATURE
(T) TYPESETTING PARAMETER



TO LINK LANGUAGE DIVERSITY (**DESIGN FEATURES**)
TO **READING COMFORT** (LEGIBILITY) AND **TYPESETTING** (LINE/WORD/LETTER SPACING)



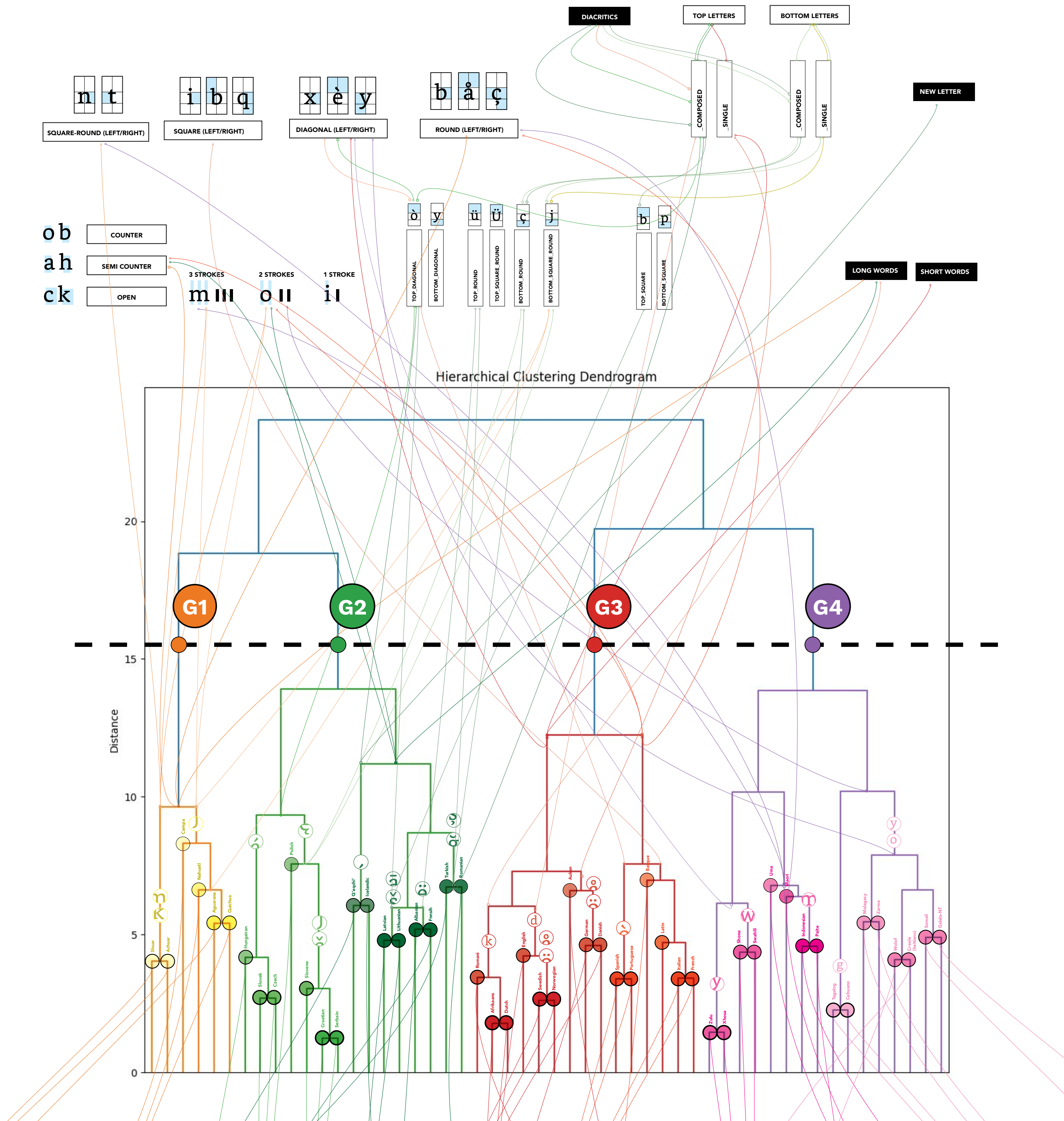
(METHOD)
Frequency analysis of
language design features
on multilingual corpus:
The Bible

Machine learning
Hierarchical clustering:
dendrogram.

Linkage criterion:
Ward’s method.

LANGUAGE DESIGN FEATURES

VISUAL CLUSTERS



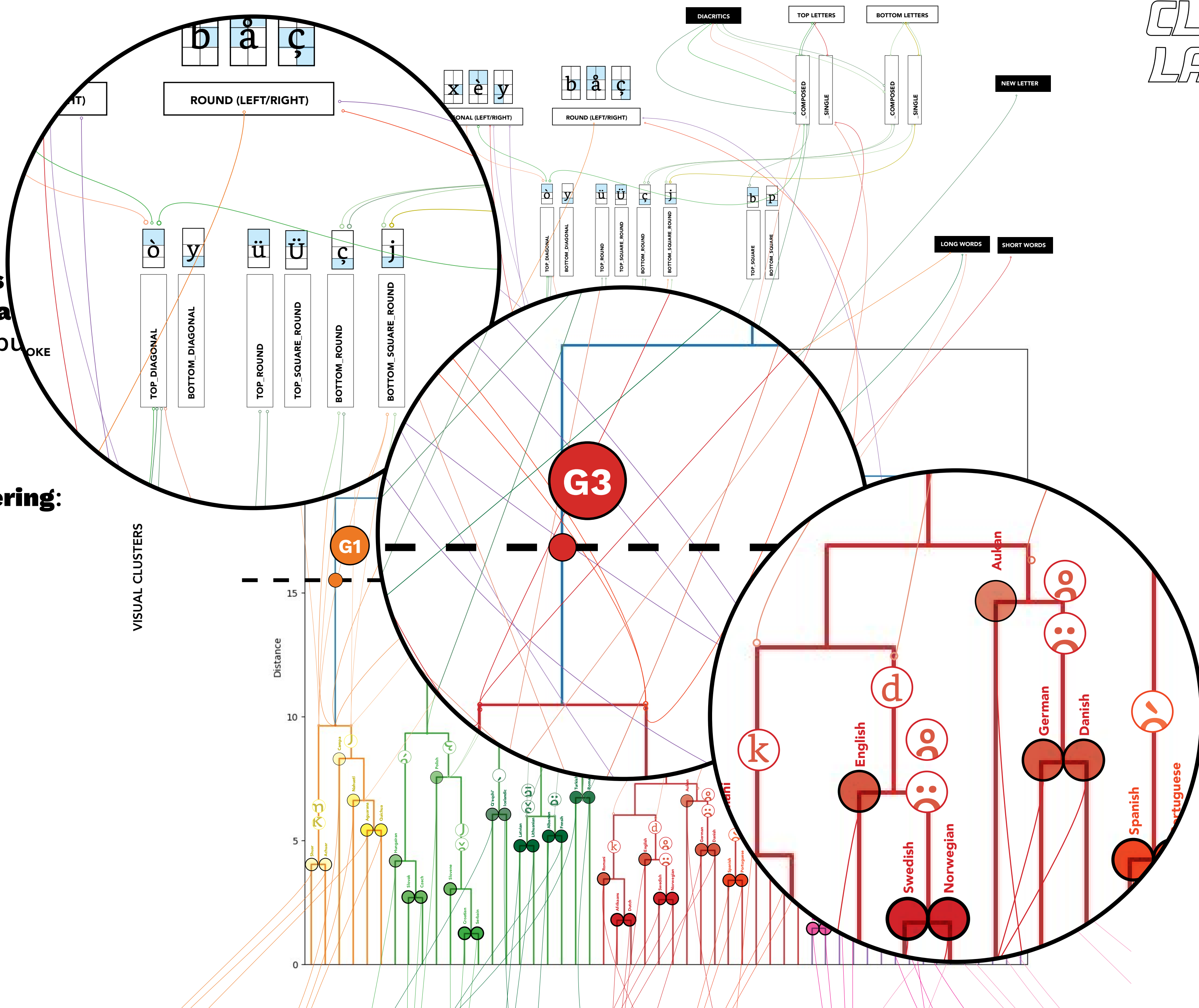
*CLUSTERS OF
LANGUAGES*

Frequency analysis language design fea on multilingual corpora The Bible

Machine learning

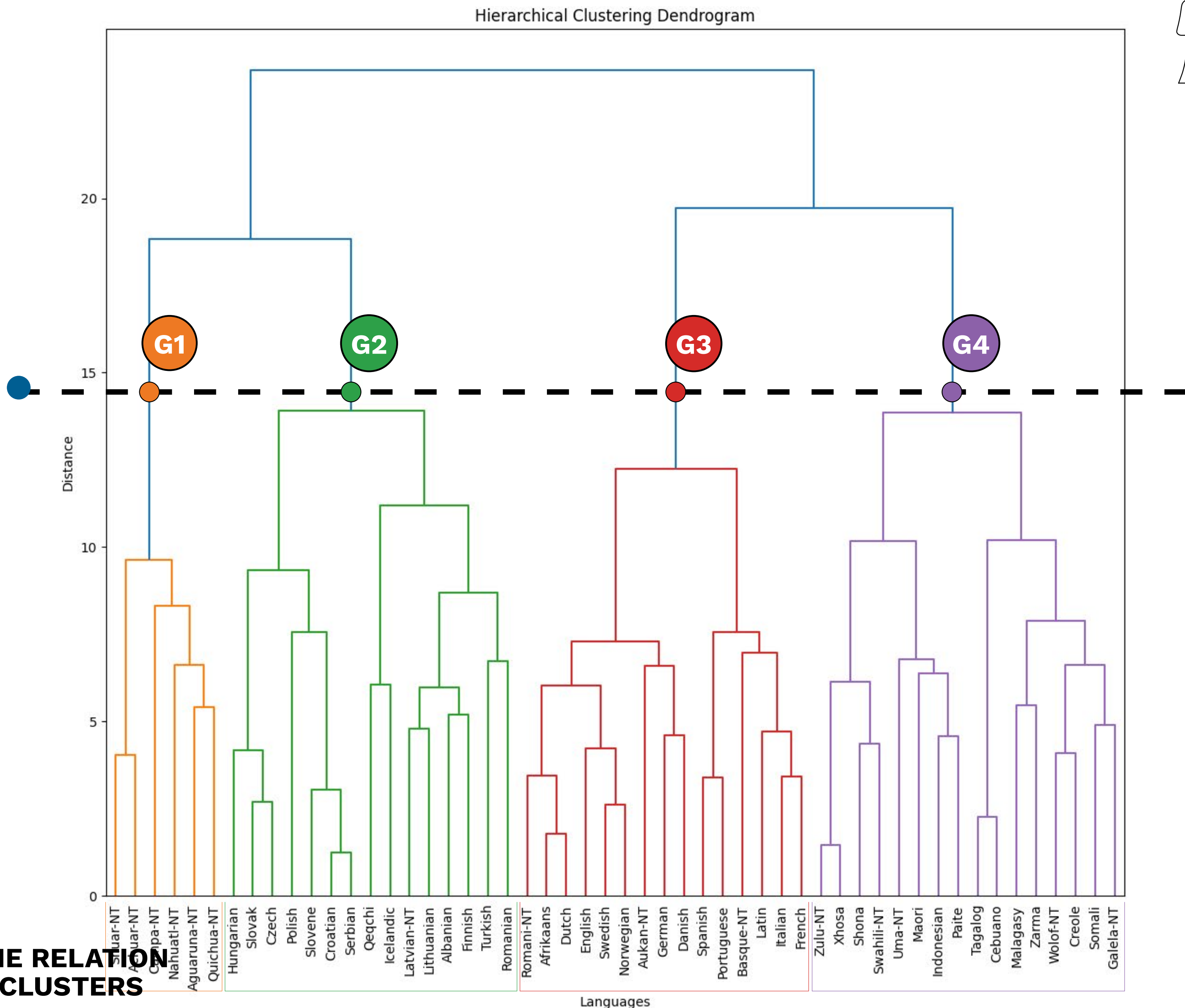
Hierarchical clustering: dendrogram.

Linkage criterion:
Ward's method.



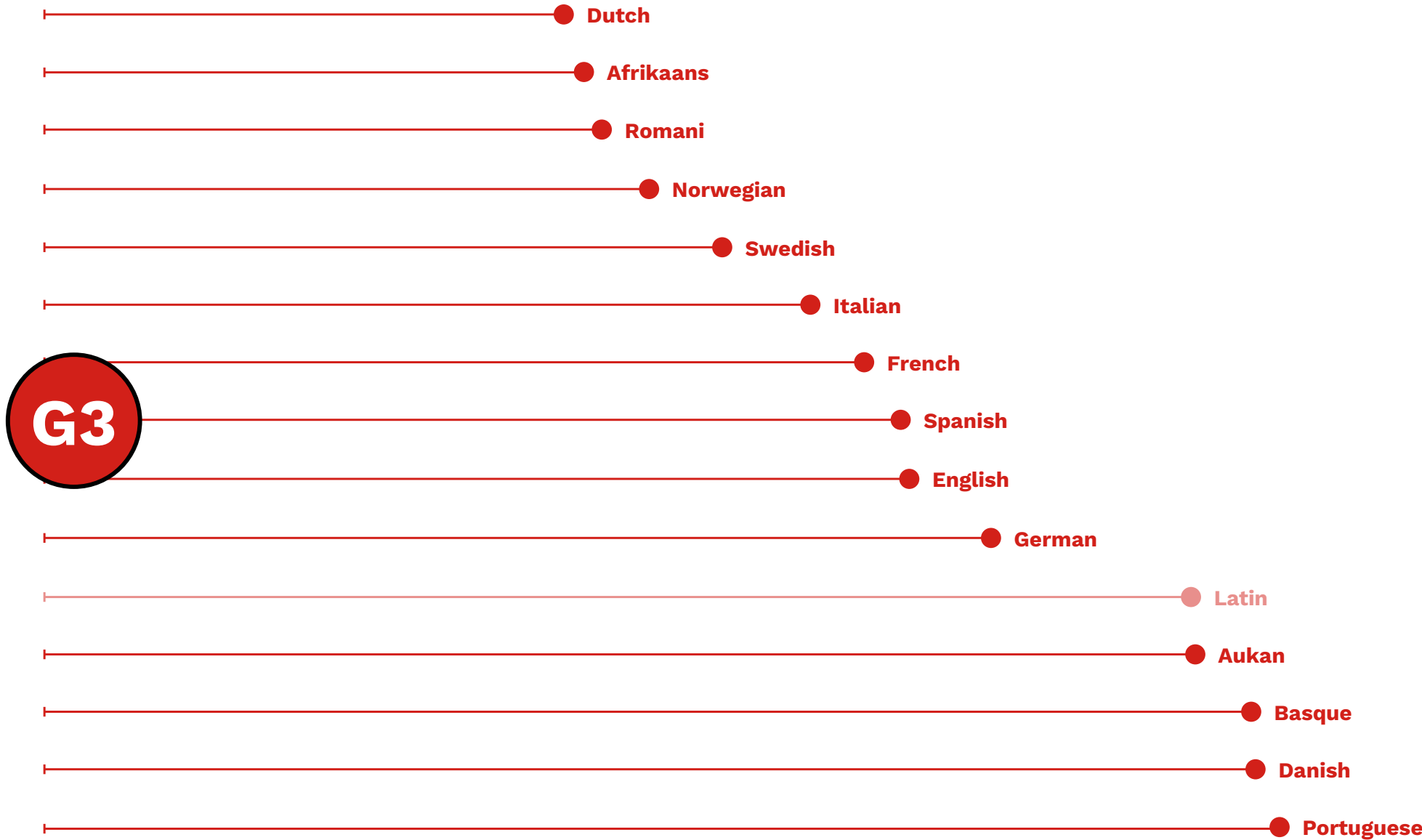
VISUAL OF THE RELATION
BETWEEN CLUSTERS

ELBOW-POINT
where the
diversity
happens

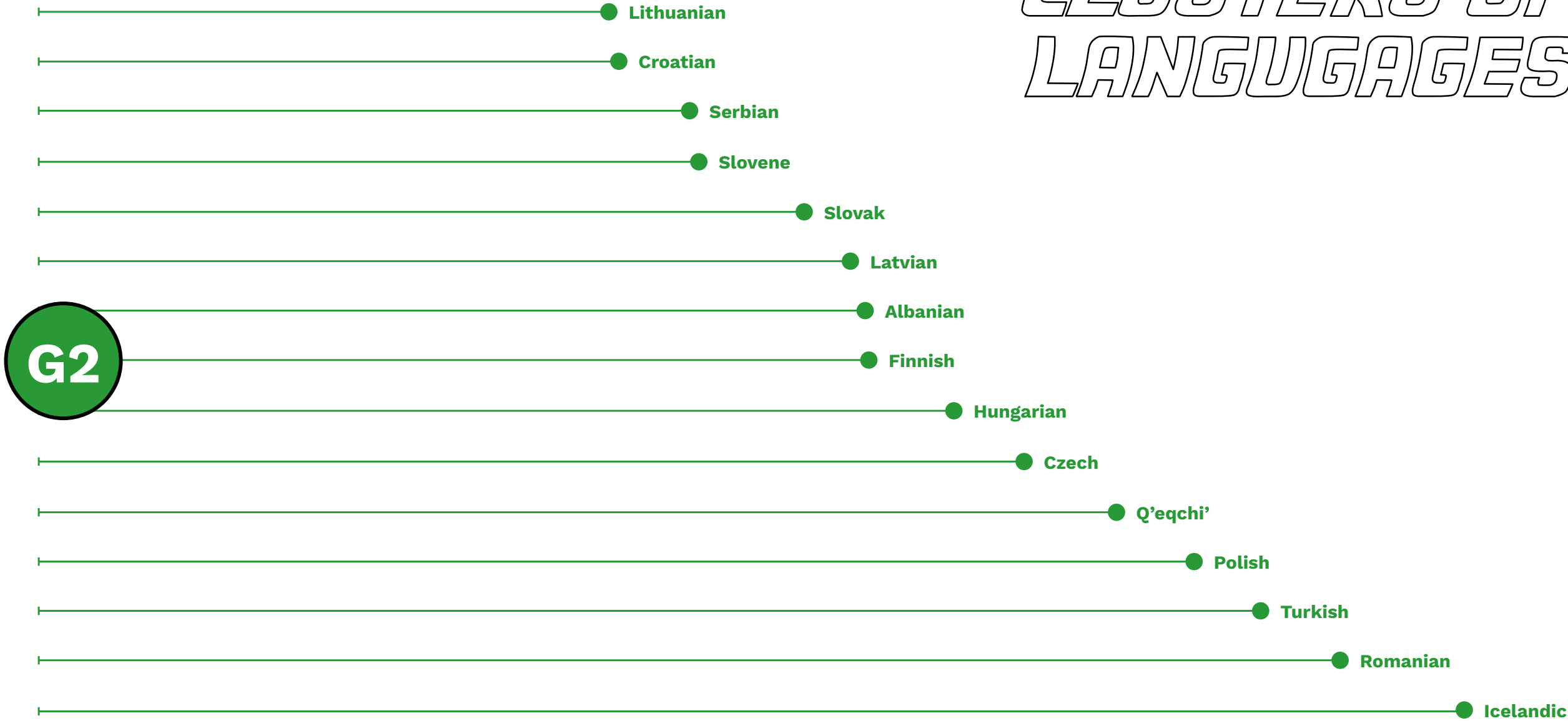


CLUSTERS OF
LANGUAGES

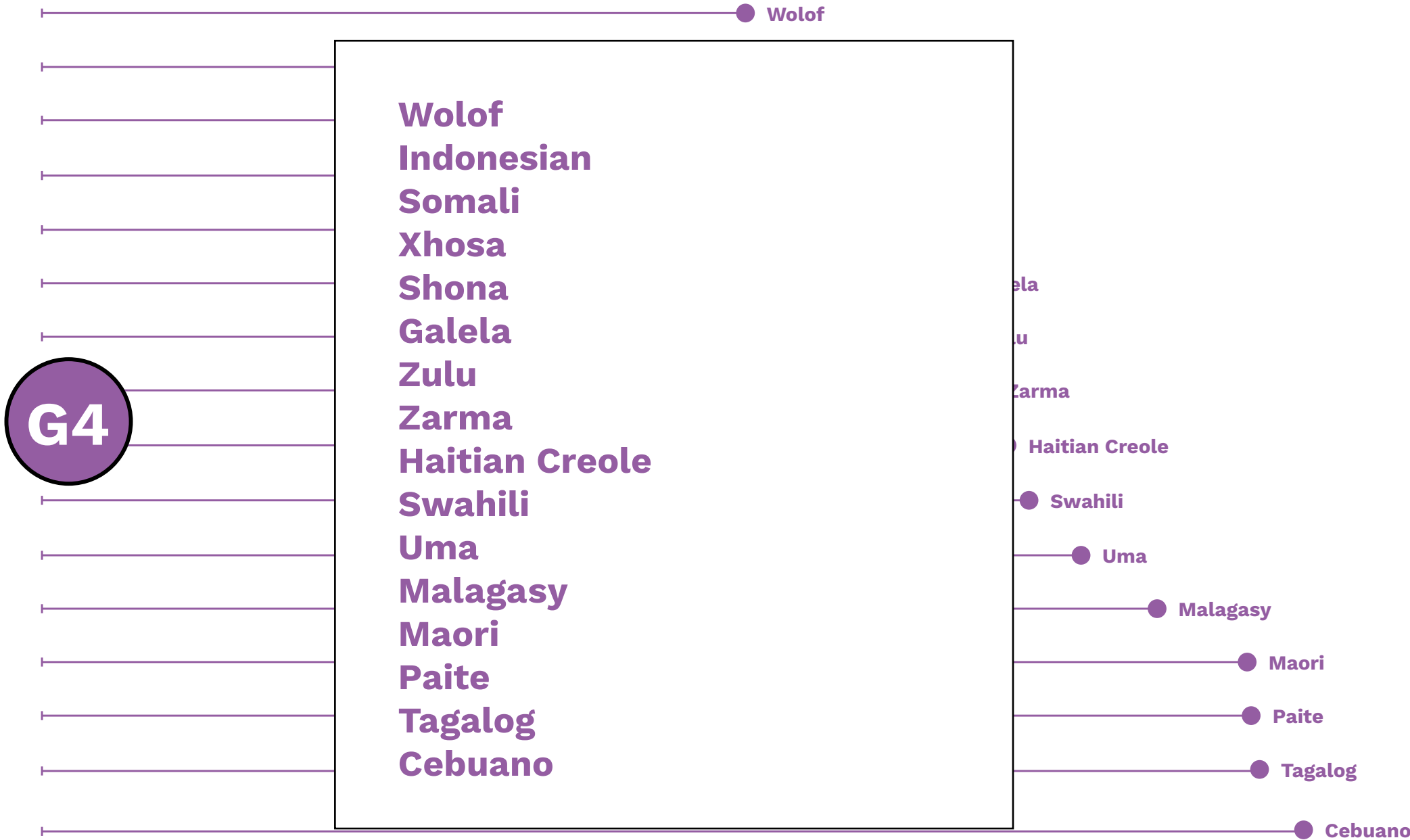
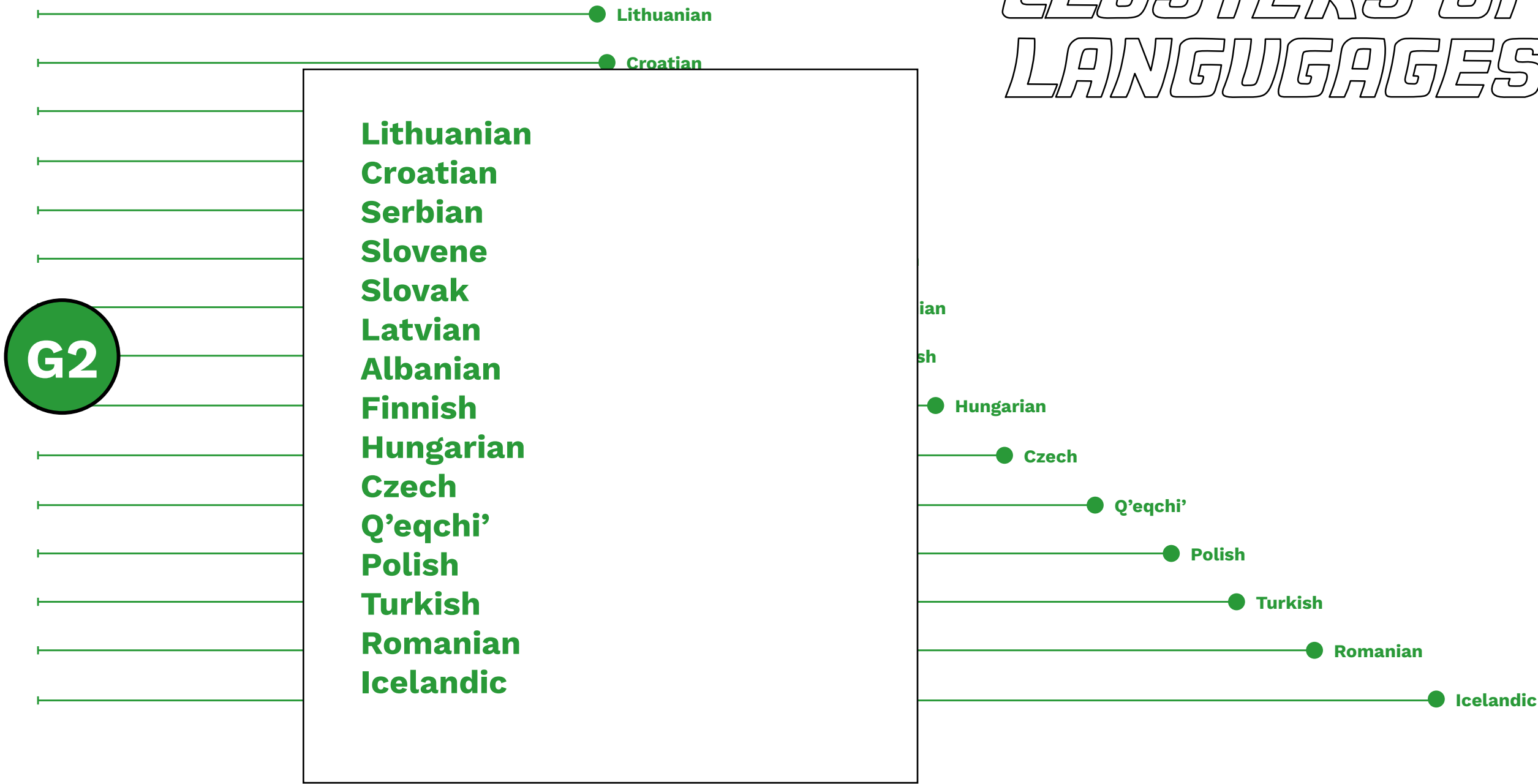
VISUAL OF THE RELATION WITHIN CLUSTERS



CLUSTERS OF LANGUGAGES

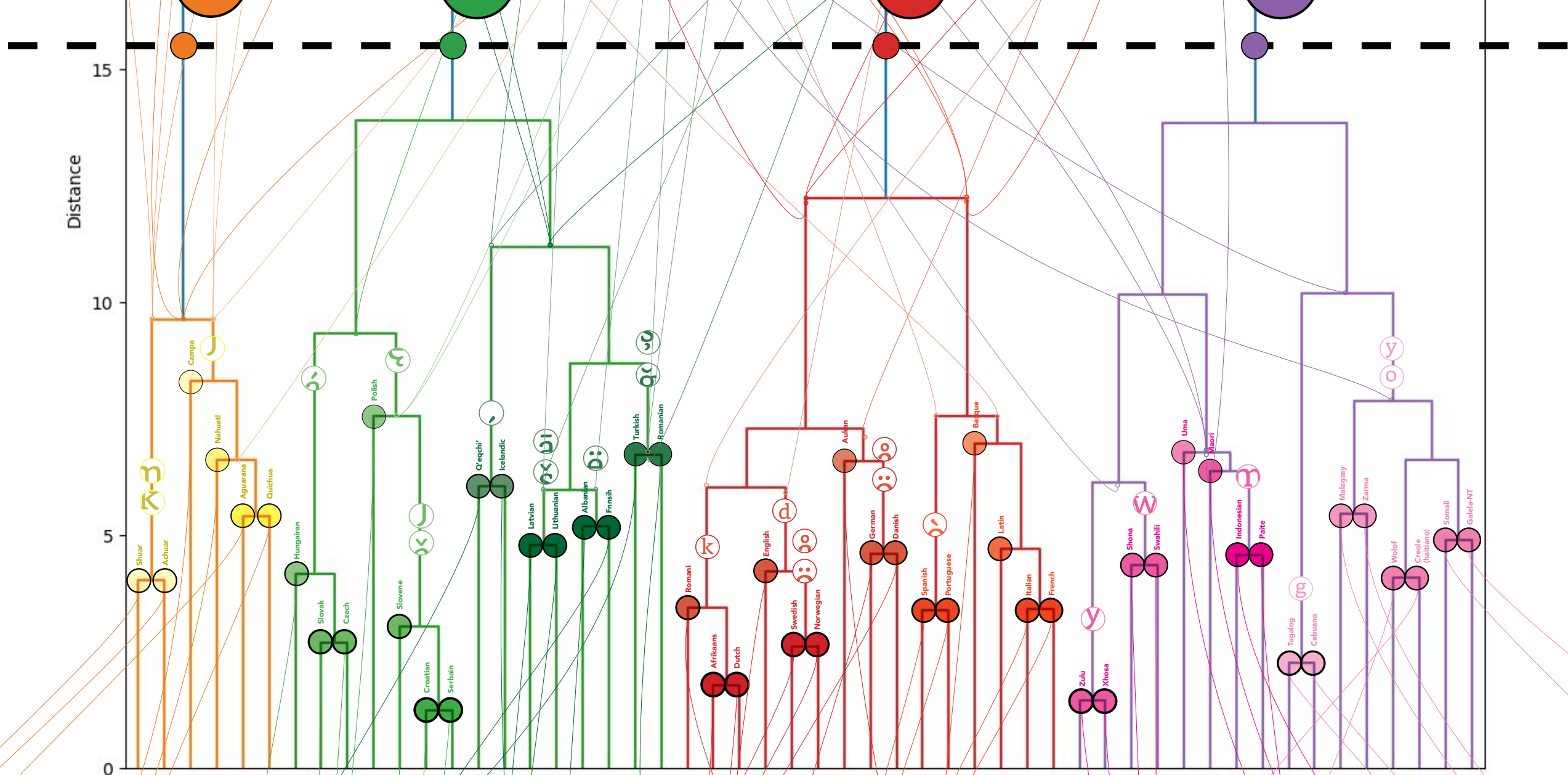


VISUAL OF THE RELATION
WITHIN CLUSTERS

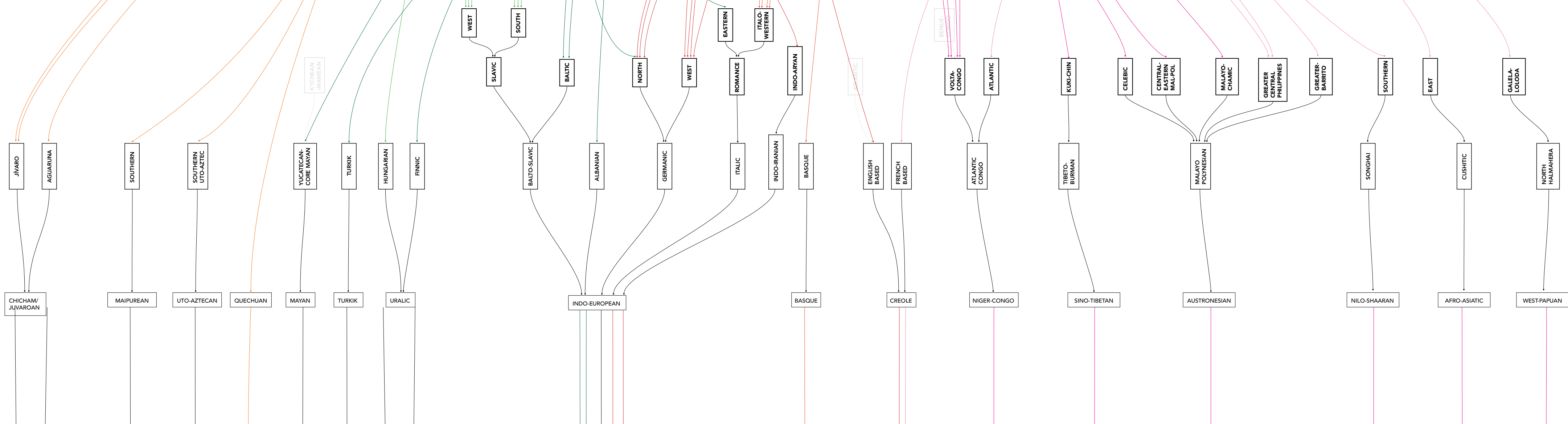


CLUSTERS OF
LANGUGAGES

CLUSTERS OF LANGUAGES



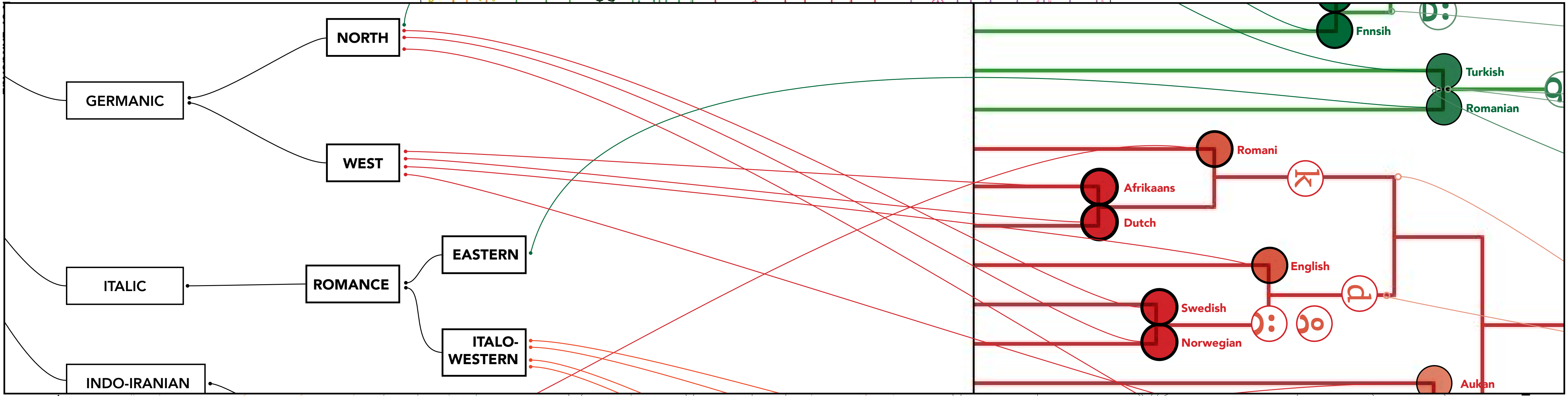
HOW VISUAL CLUSTERS RELATES TO LINGUISTIC FAMILIES?



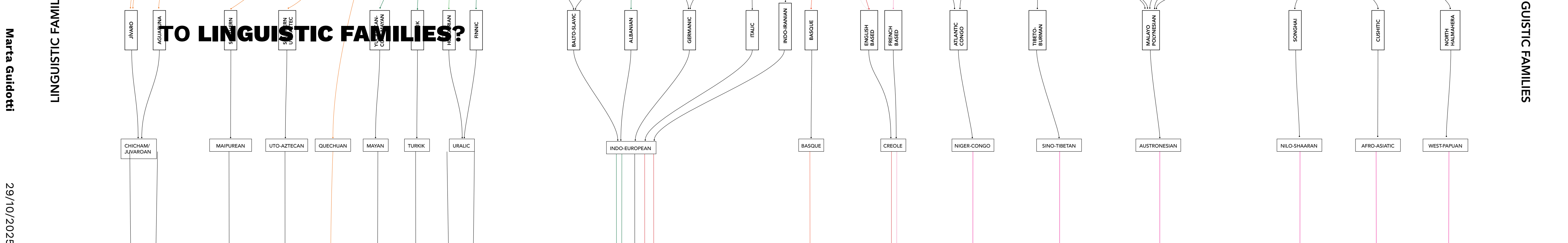
LINGUISTIC FAMILIES

CLUSTERS OF LANGUAGES

HOW VISUAL CLUSTERS RELATES

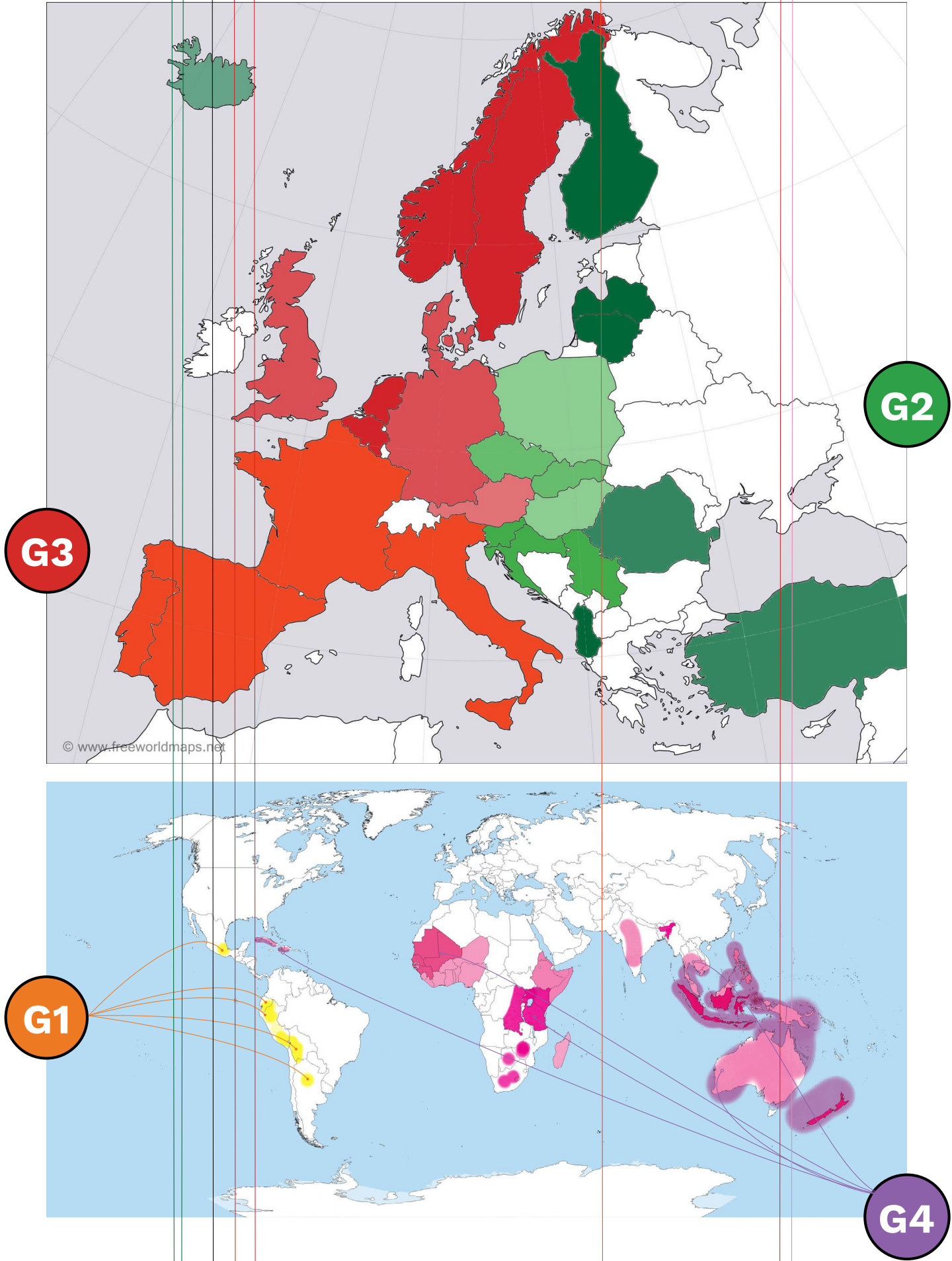


TO LINGUISTIC FAMILIES?



CLUSTERS OF LANGUGAGES

CLUSTERS COUNTRY MAP

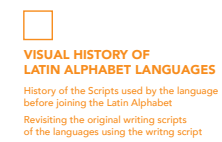
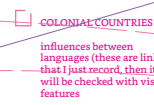
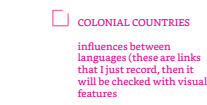


CLUSTERS COUNTRY MAP

HOW VISUAL CLUSTERS RELATES TO GEOGRAPHY?

CLUSTERS OF LANGUAGES

2024.02.06 – 2024.02.14



HOW VISUAL CLUSTERS RELATES TO WRITING ROOTS?



HISTORY OF WRITING / ROOTS OF WRITING

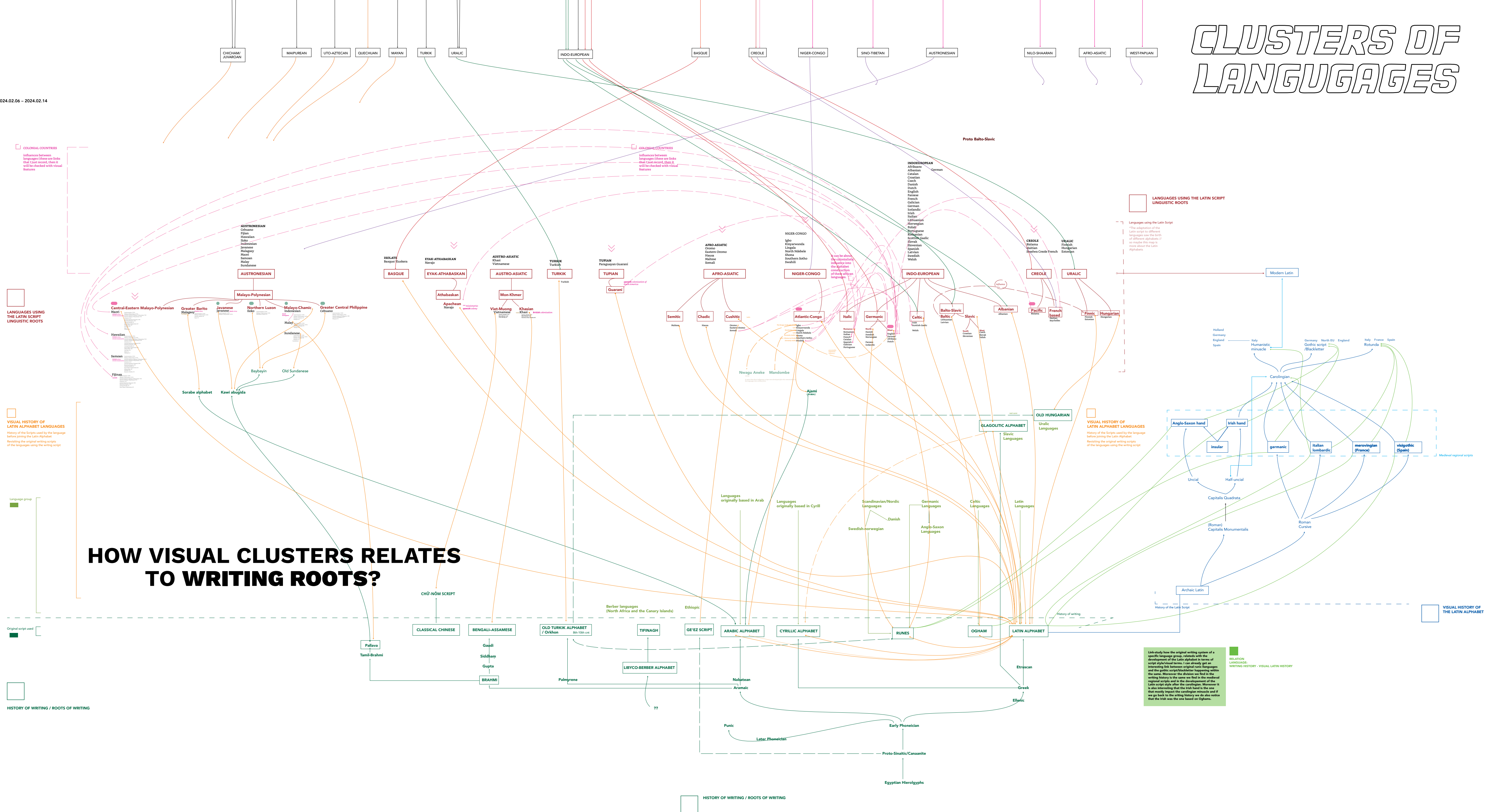


Languages using the Latin Script
 *The adaptation of the Latin script to different languages saw the birth of different alphabets // so maybe this map is more about the Latin Alphabets



Link-study how the original writing system of a specific language group, related with the development of the Latin alphabet in terms of script style/visual terms. I can already get an interesting link between original runic languages and the gothic script/blackletter happening within the same. Moreover the division we find in the writing history is the same we find in the medieval regional scripts and in the development of the Latin script style after the carolingian. Moreover it is also interesting that the Irish hand is the one that mostly impact the carolingian minuscule and if we go back to the writing history we do also notice that the Irish was the one based on Oghams.

RELATION
LANGUAGE:
WRITING HISTORY - VISUAL LATIN HISTORY



HOW VISUAL CLUSTERS RELATES TO WRITING ROOTS?

HOW VISUAL CLUSTERS RELATES TO WRITING ROOTS?

CLUSTERS OF LANGUGAGES

A page from the Flowery Triodion (Triod' svetnaja), a Polish book printed in Kraków in about 1491, one of the oldest printed Byzantine-Slavonic books, National Library of Poland

Leaf 170r of the Book of Ballymore contains illustrations and explanations of the Ogham script from the text Auircept na n-Éces, 1390 or 139

COLONIAL COUNTRIES

Influence between languages (these are links that I just record, then it will be checked with visual features)

LANGUAGES USING THE LATIN SCRIPT

LINGUISTIC ROOTS

VISUAL HISTORY OF LATIN ALPHABET LANGUAGES

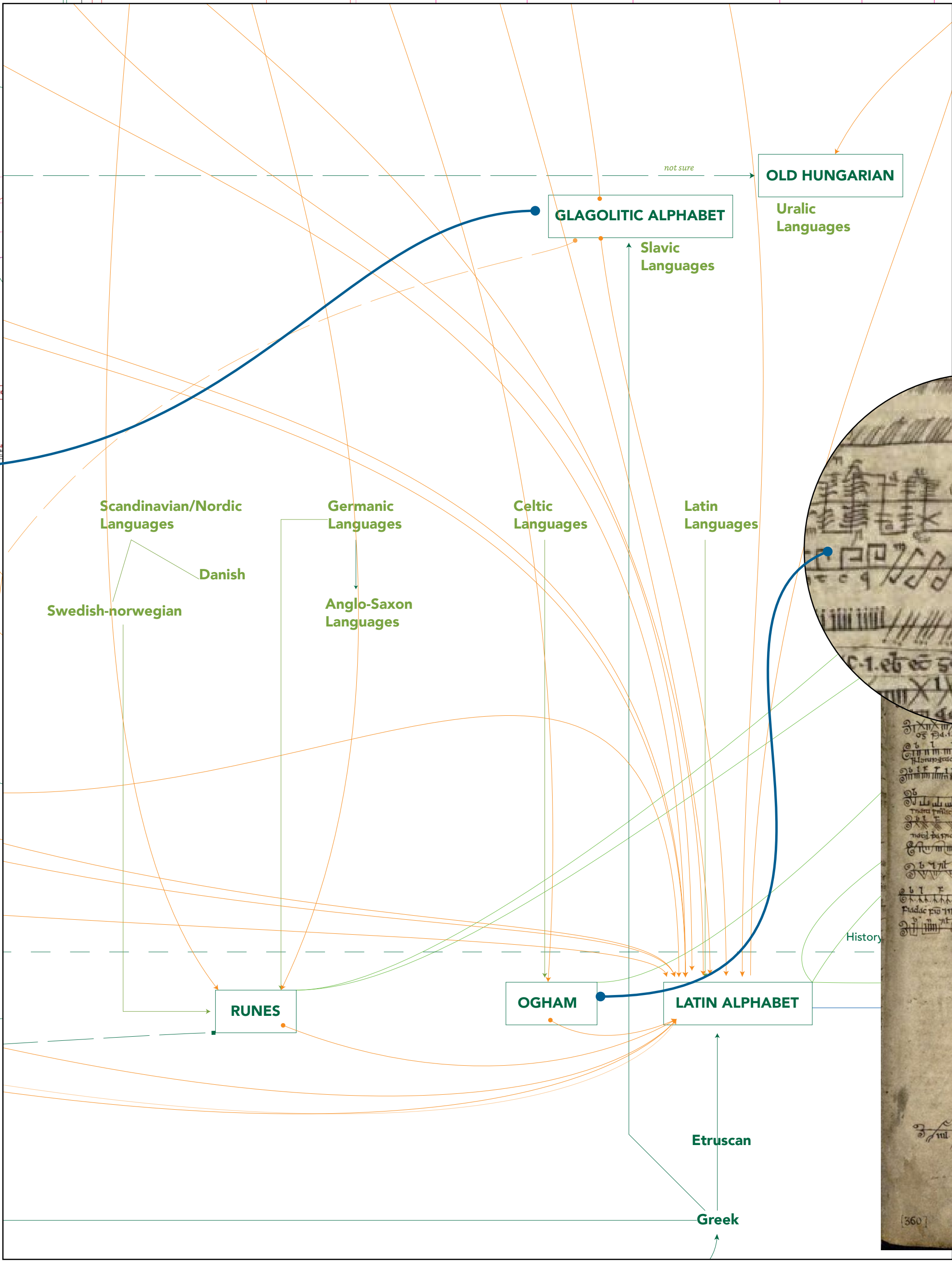
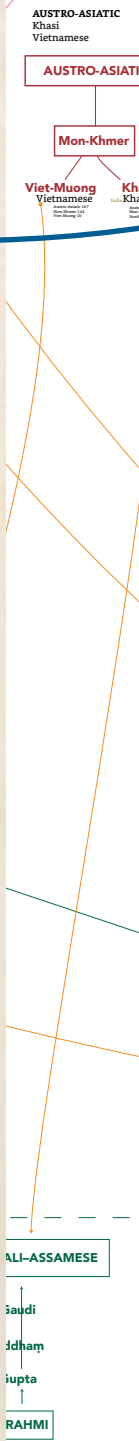
History of the scripts used by the language before joining the Latin Alphabet

Revealing the original writing scripts of the languages using the writing script

Language group

Original script used

HISTORY OF WRITING / ROOTS OF WRITING

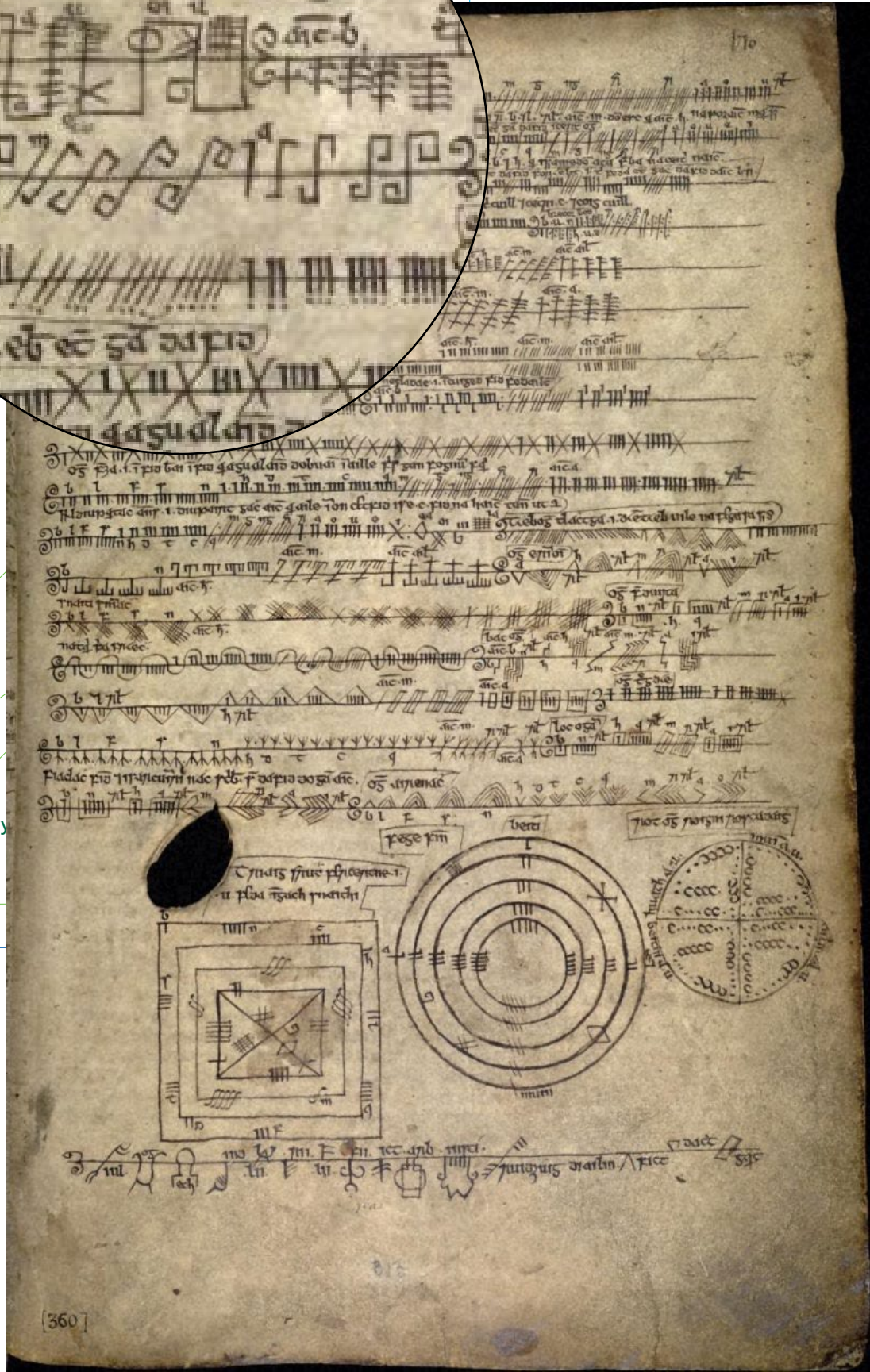
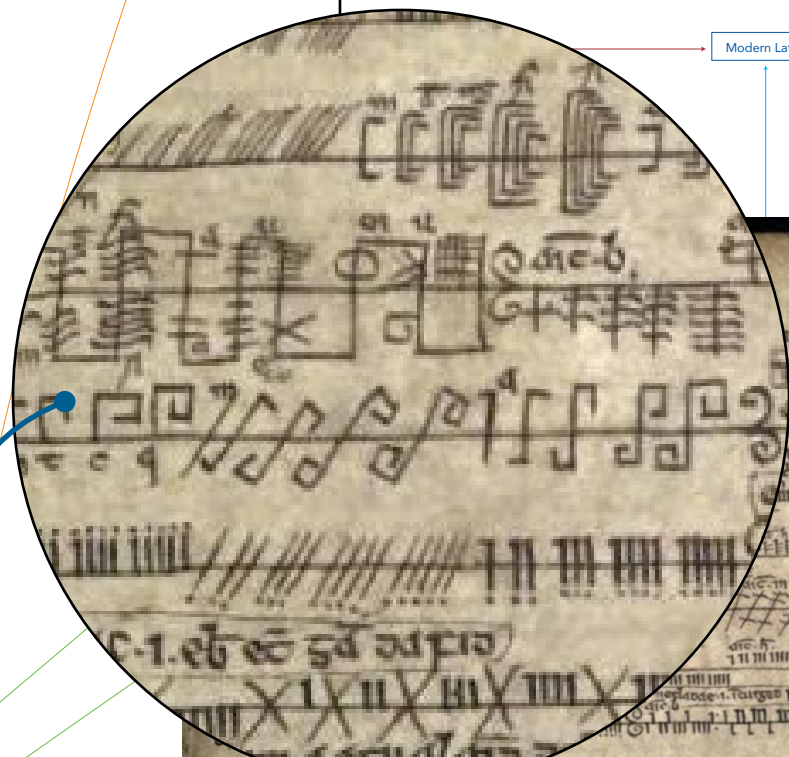


LANGUAGES USING THE LATIN SCRIPT

LINGUISTIC ROOTS

Latin Script

Modern Latin



VISUAL HISTORY OF THE LATIN ALPHABET

HOW VISUAL CLUSTERS RELATES TO WRITING ROOTS?

COLONIAL COUNTRIES
Influences between languages (these are links that I just record, then it will be checked with visual features)

LANGUAGES USING THE LATIN SCRIPT
LINGUISTIC ROOTS

VISUAL HISTORY OF LATIN ALPHABET LANGUAGES
History of the scripts used by the language before joining the Latin Alphabet
Revealing the original writing scripts of the languages using the writing script

Language group

Original script used

HISTORY OF WRITING / ROOTS OF WRITING

CHICHAM/JUARSAN

MAIPUREAN

UTO-AZTECAN

QUECHUAN

MAYAN

TUROK

URALIC

AUSTRO-ASIATIC
Khmer
Vietnamese
AUSTRO-ASIATIC
Mon-Khmer
Viet-Muong
Vietnamese
Khmer

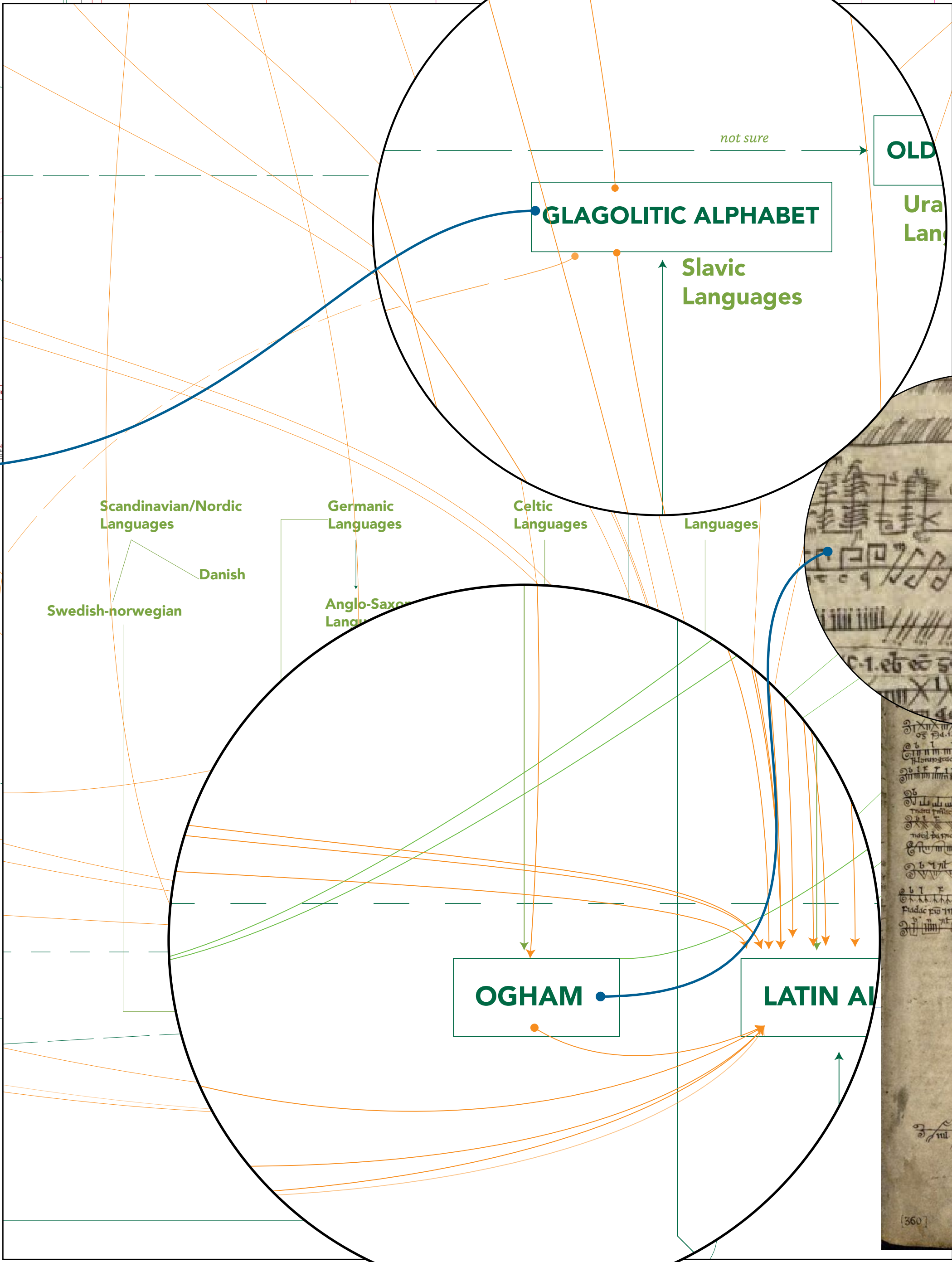
ALL-ASSAMESE

Saadi

Scham

Iugta

RAHMI



CLUSTERS OF LANGUAGES

LANGUAGES USING THE LATIN SCRIPT
LINGUISTIC ROOTS

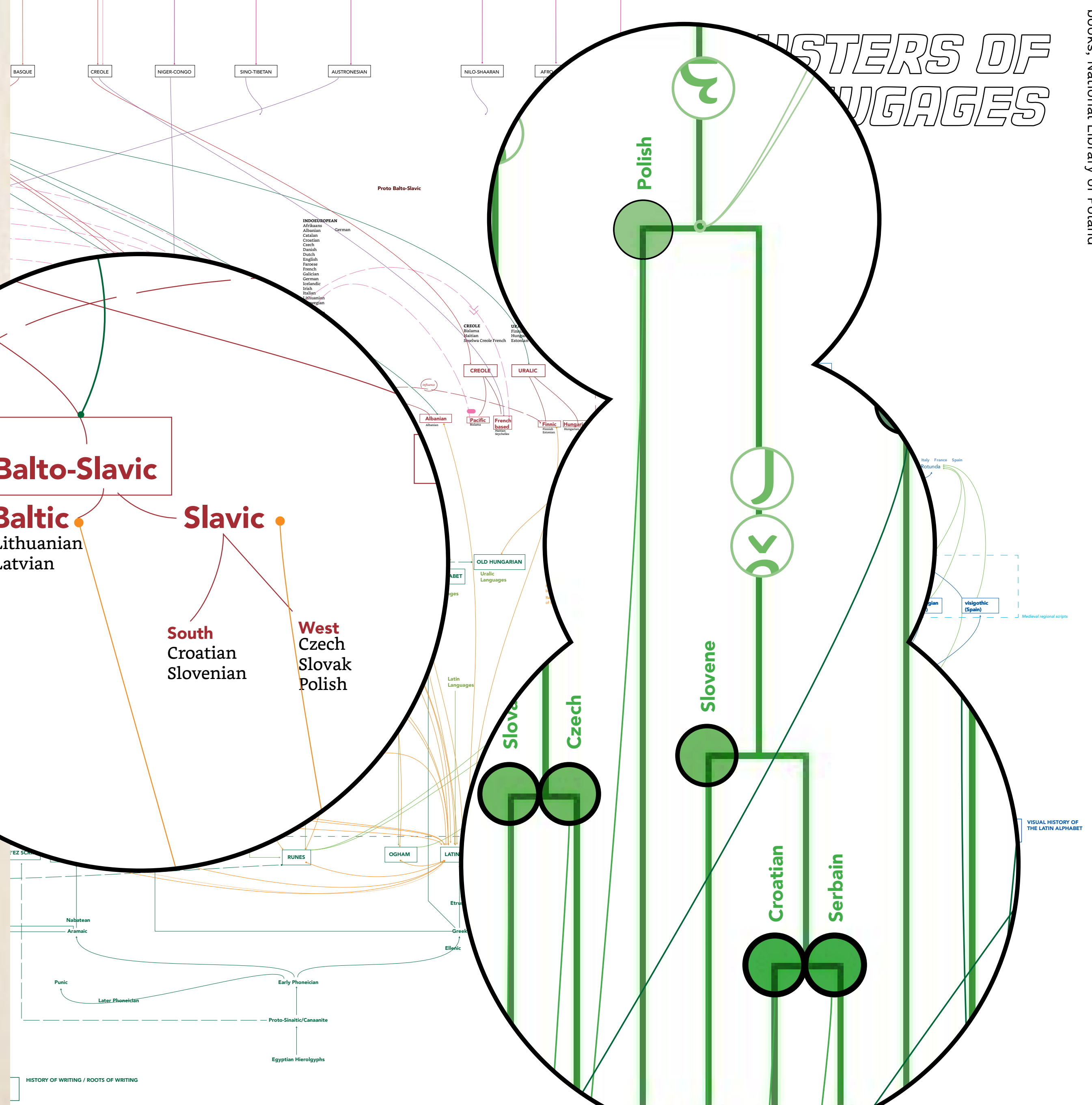
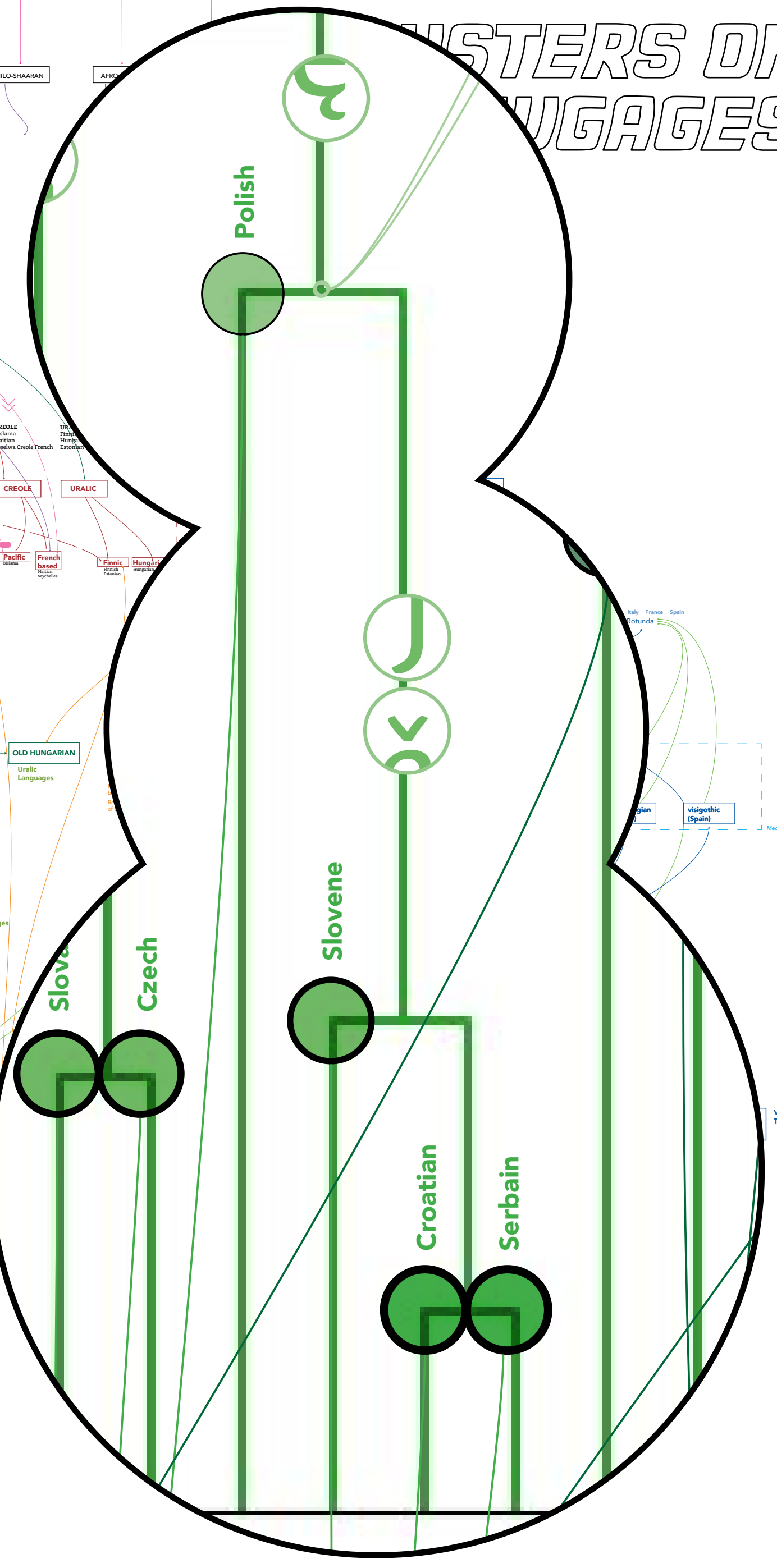
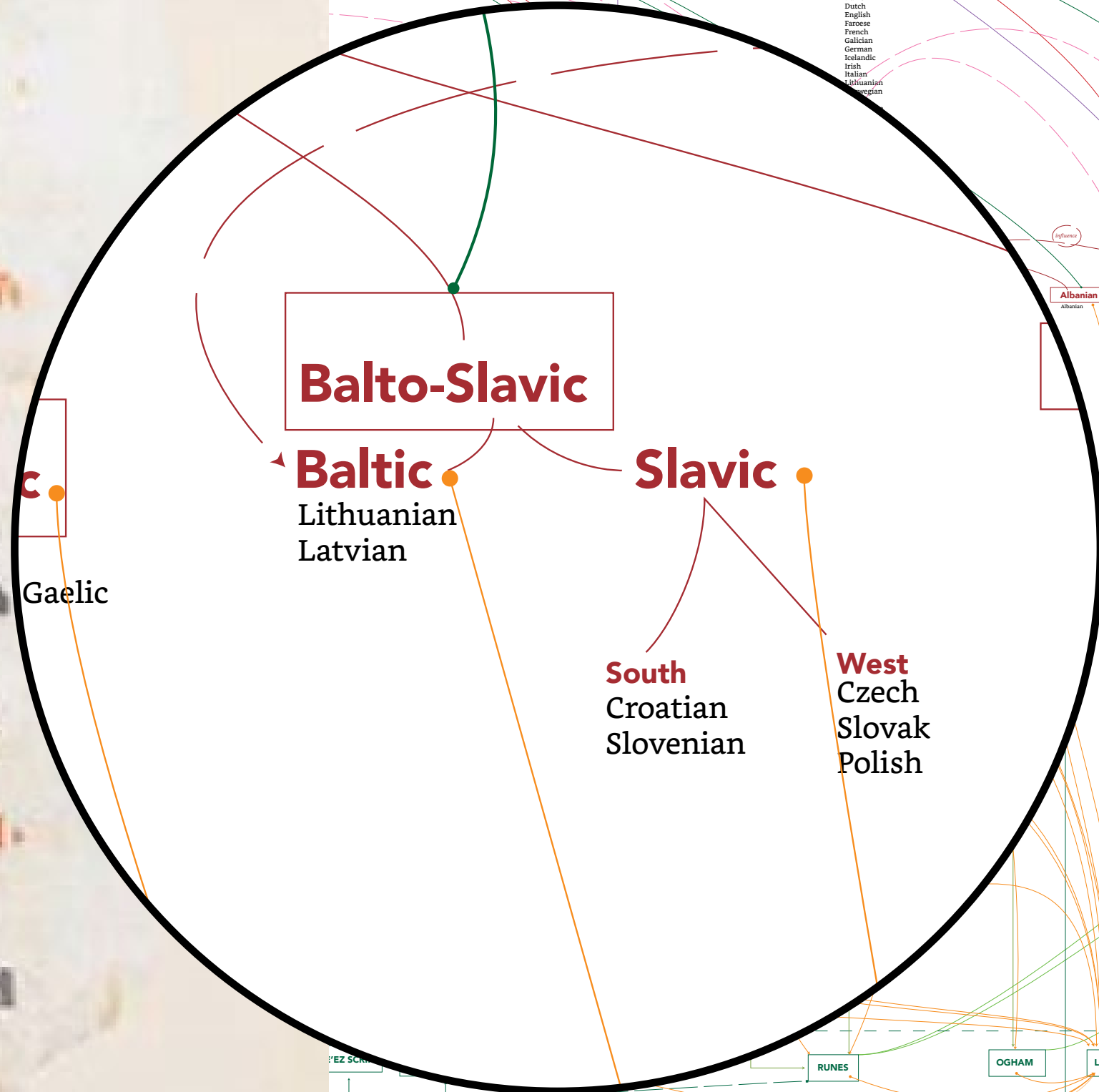
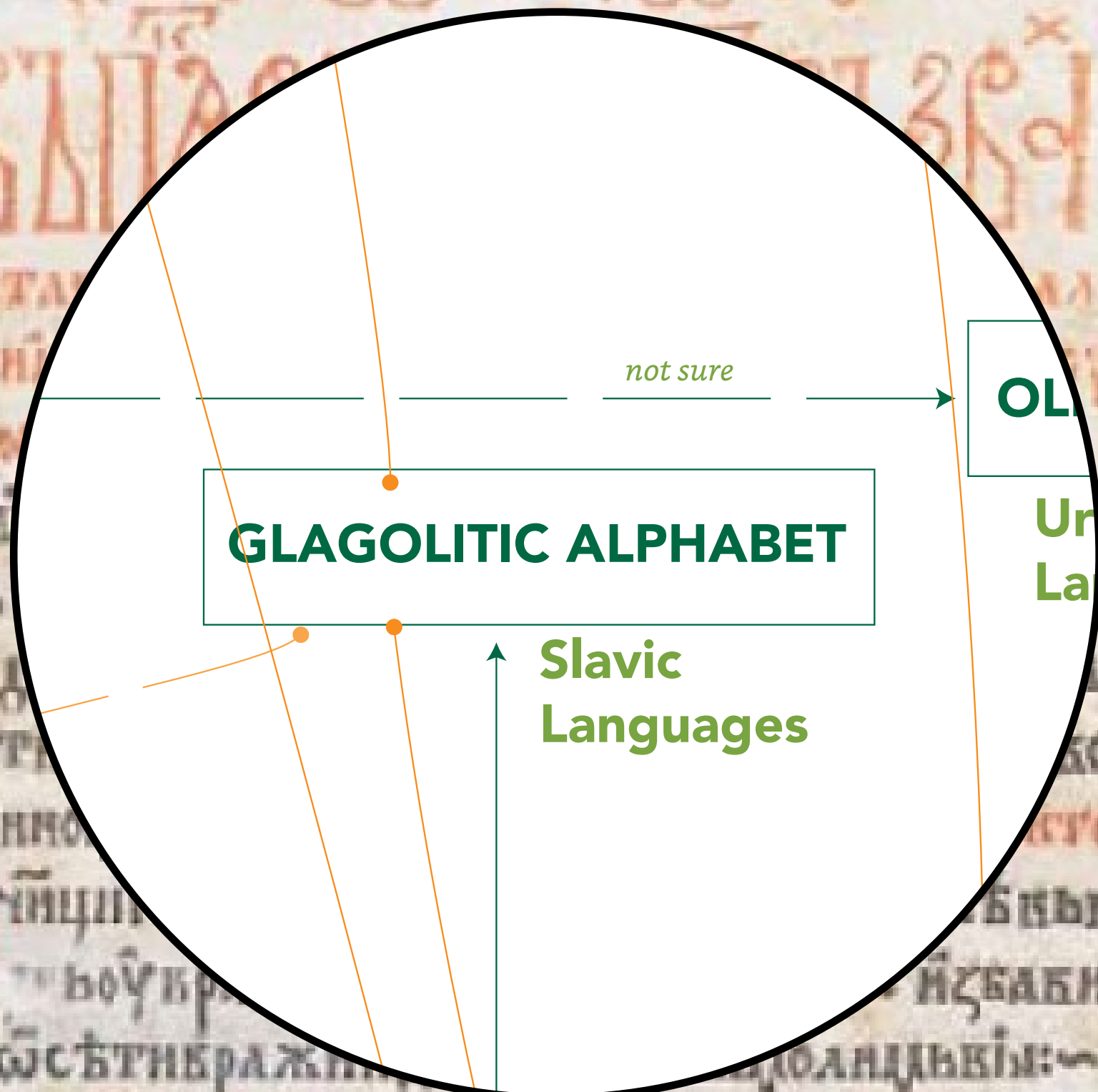
Latin Script
Latin
Greek
Hebrew
Arabic
Sanskrit

Modern Latin



VISUAL HISTORY OF THE LATIN ALPHABET

HOW VISUAL CLUSTERS RELATES TO WRITING ROOTS?

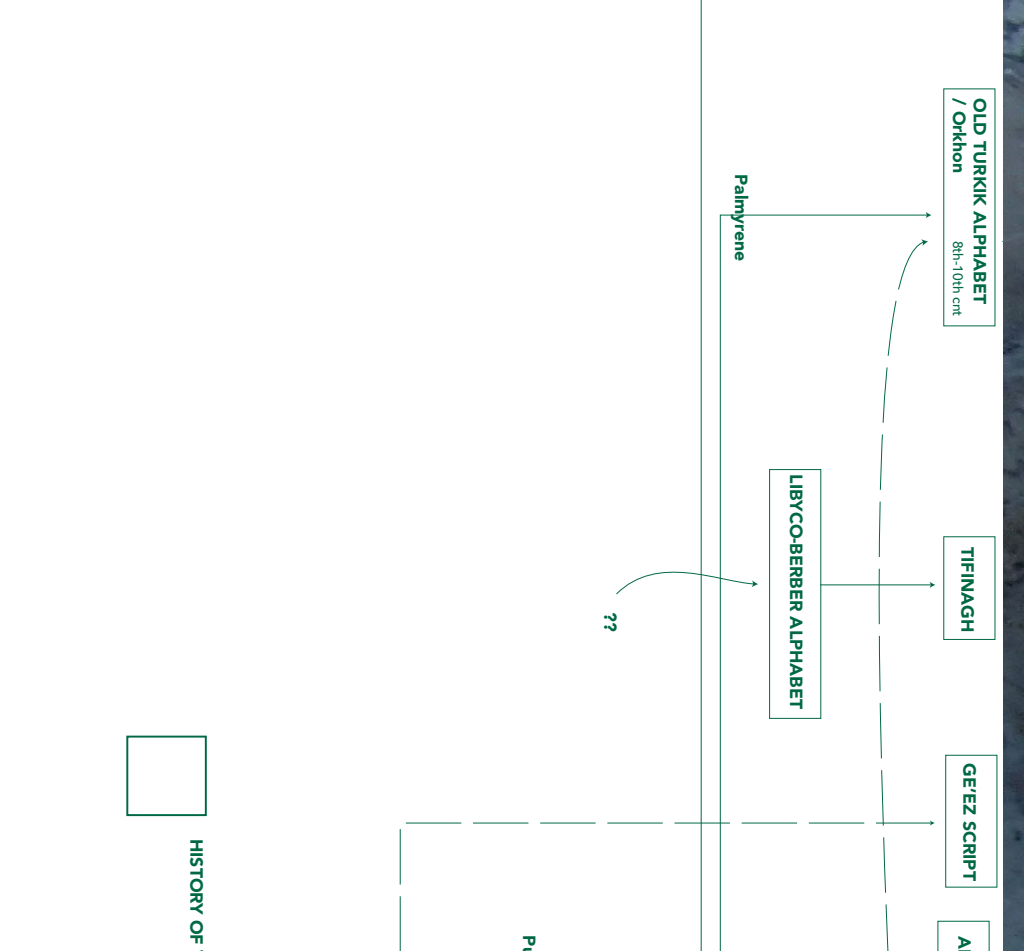
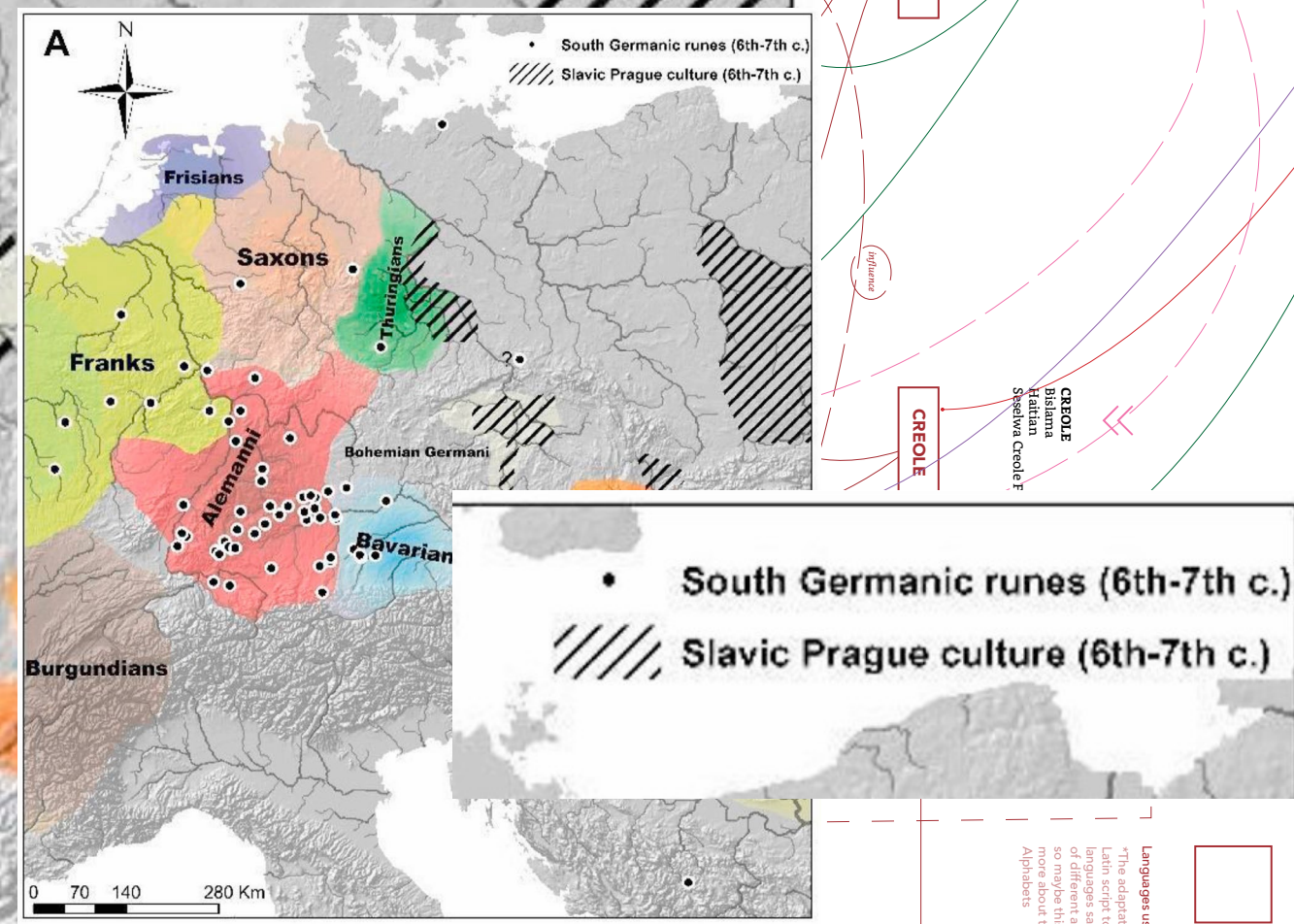
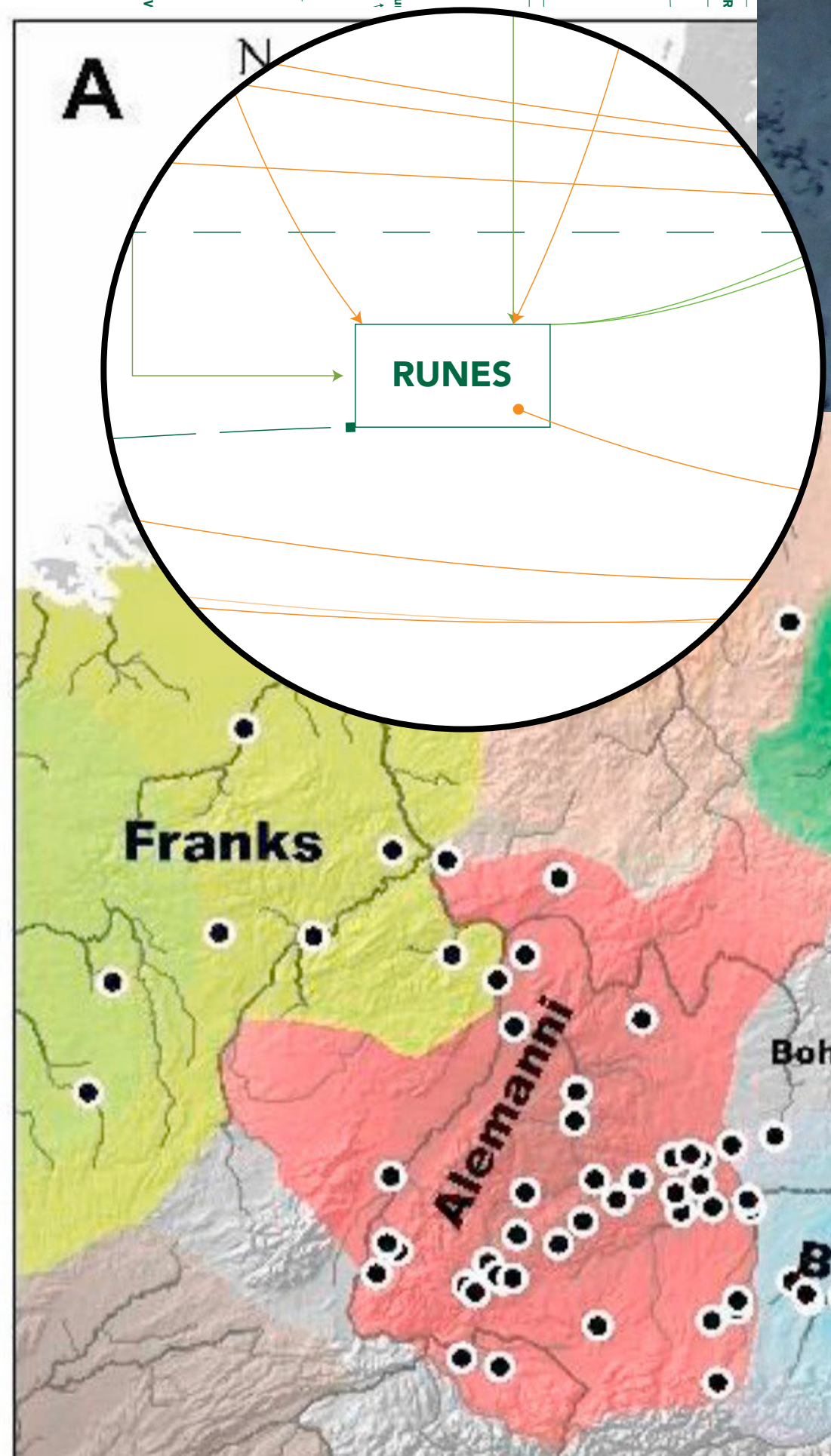
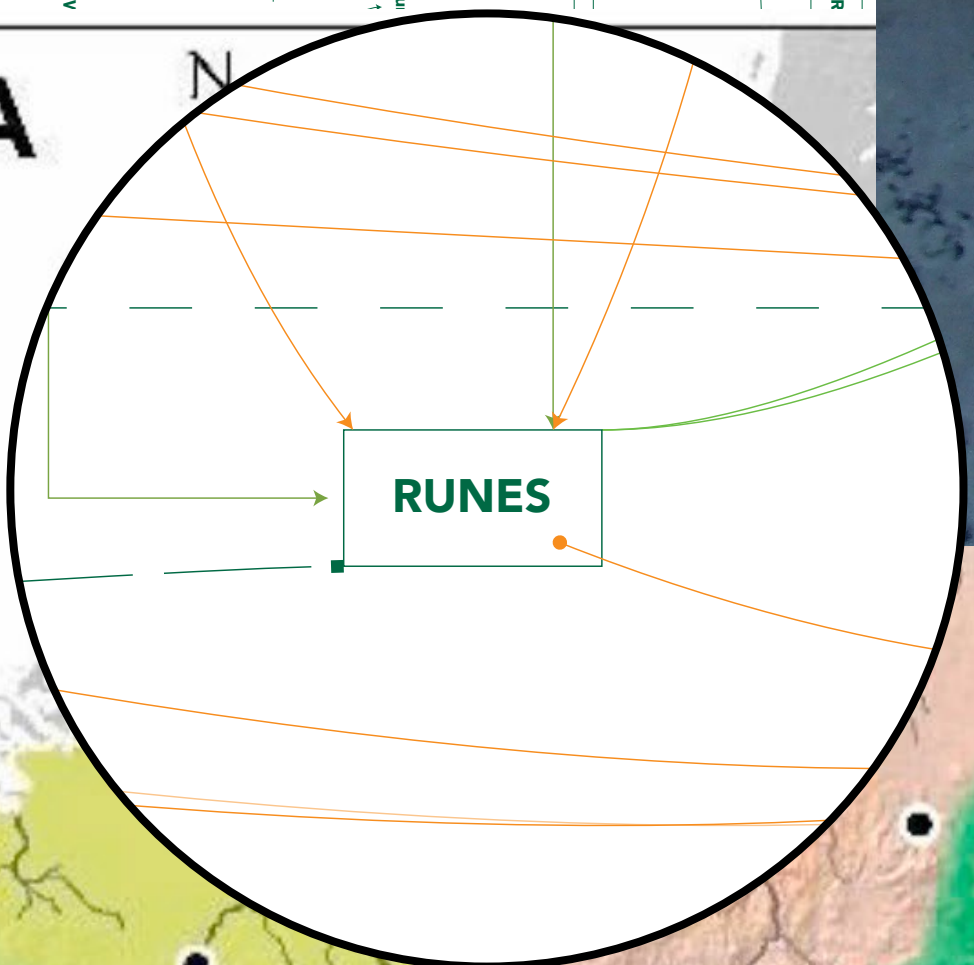
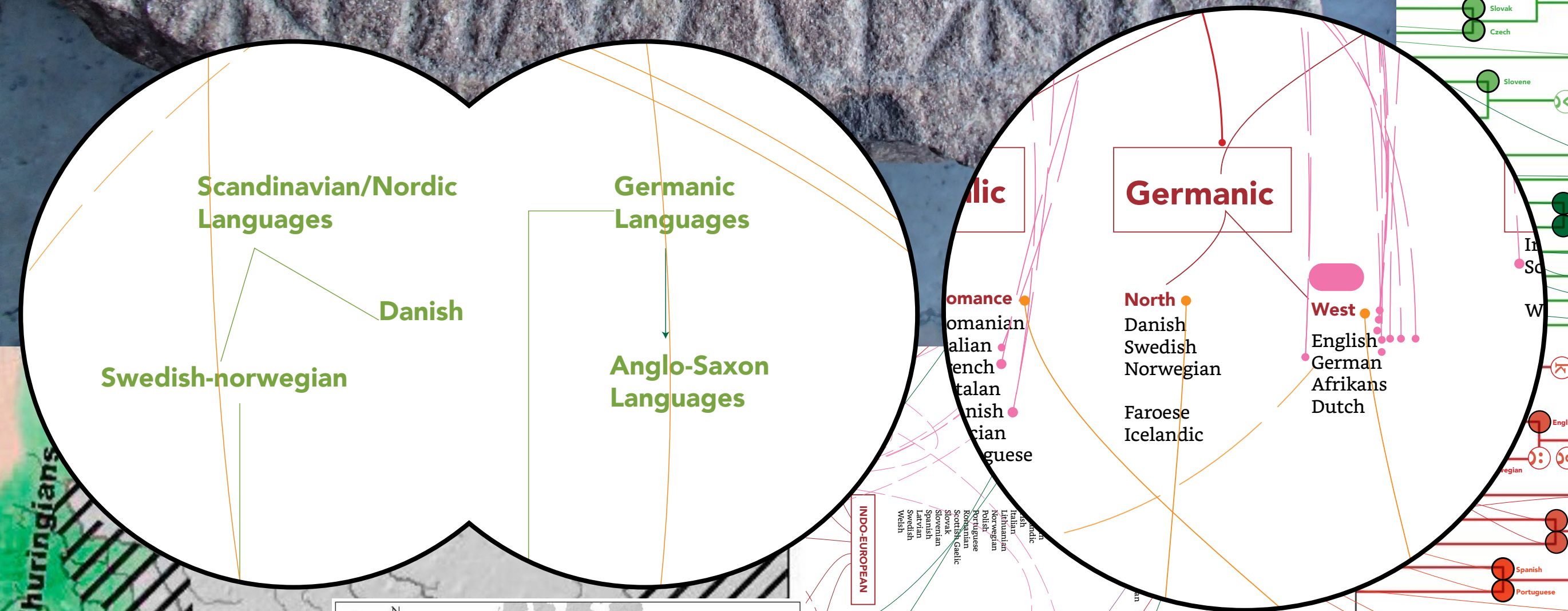
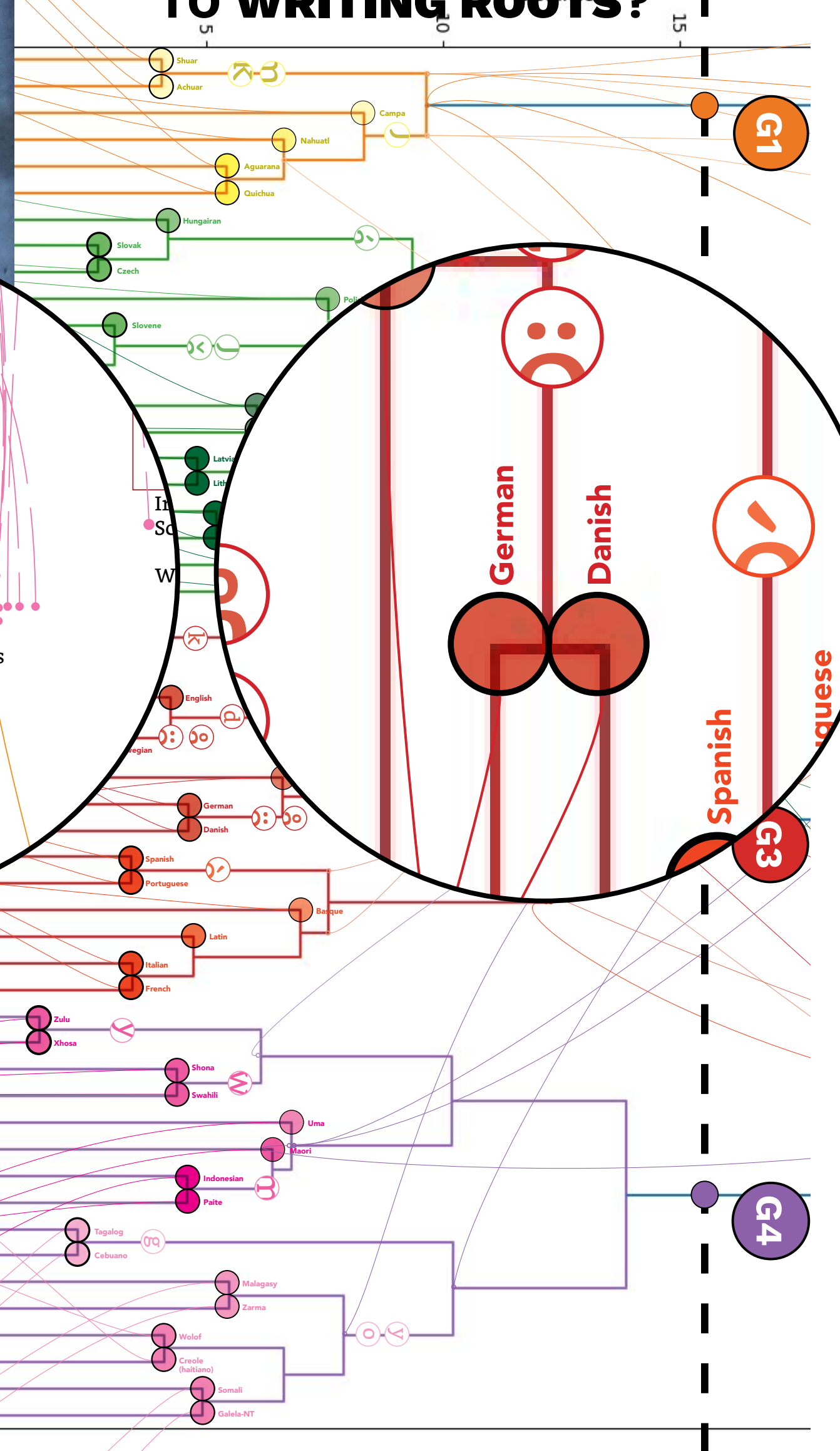


MASTERS OF LANGUAGES

CLUSTERS OF LANGUAGES

VISUAL CLUSTERS

HOW VISUAL CLUSTERS RELATES TO WRITING ROOTS?

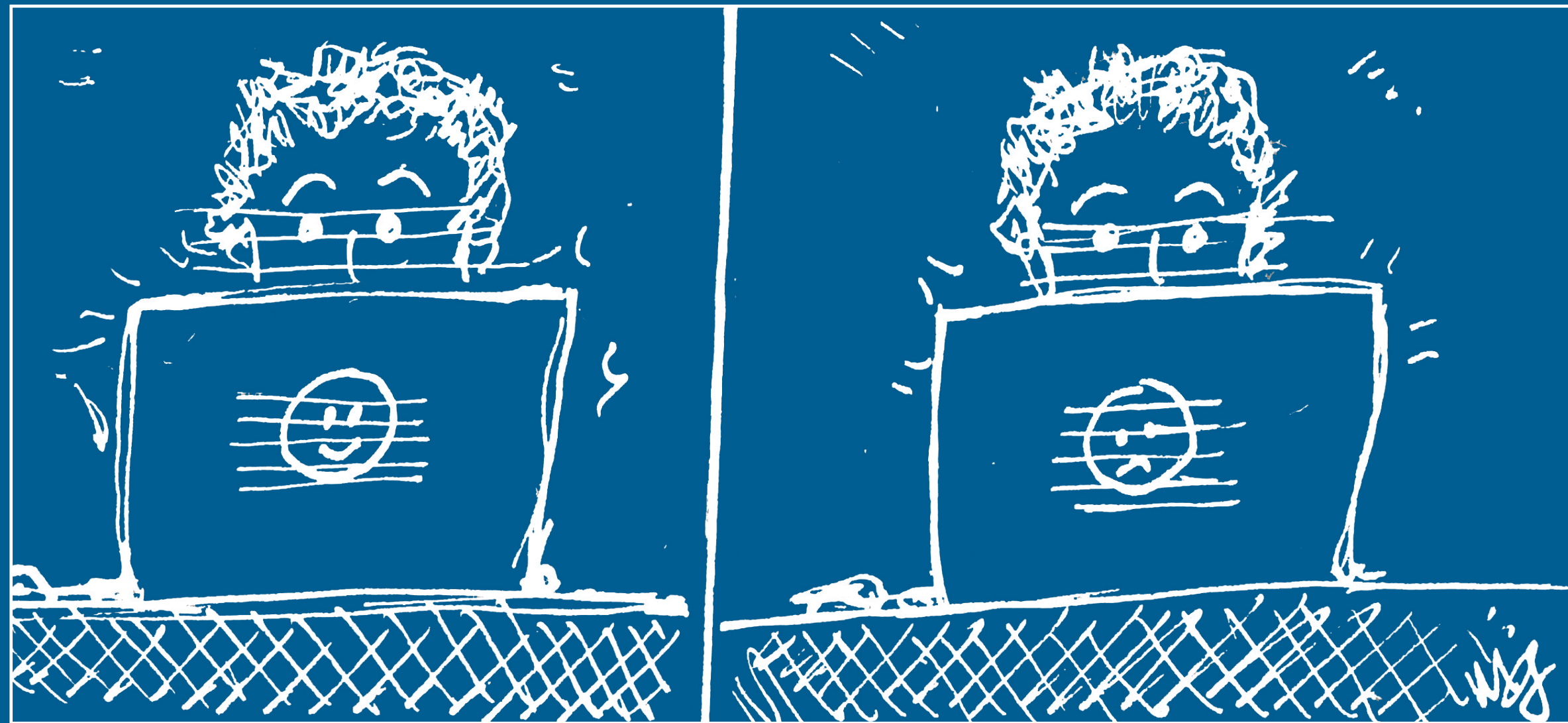




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**All languages
in Latin script**

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THANK
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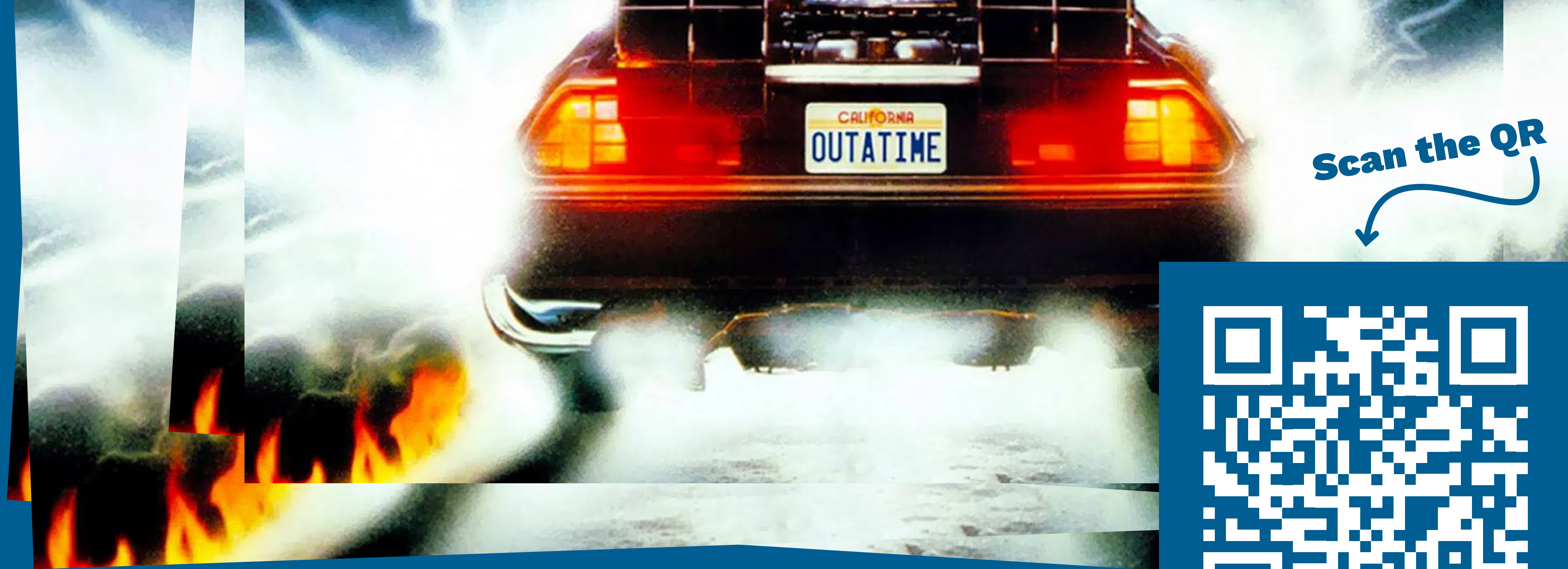
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From graphematic forms to meaning

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