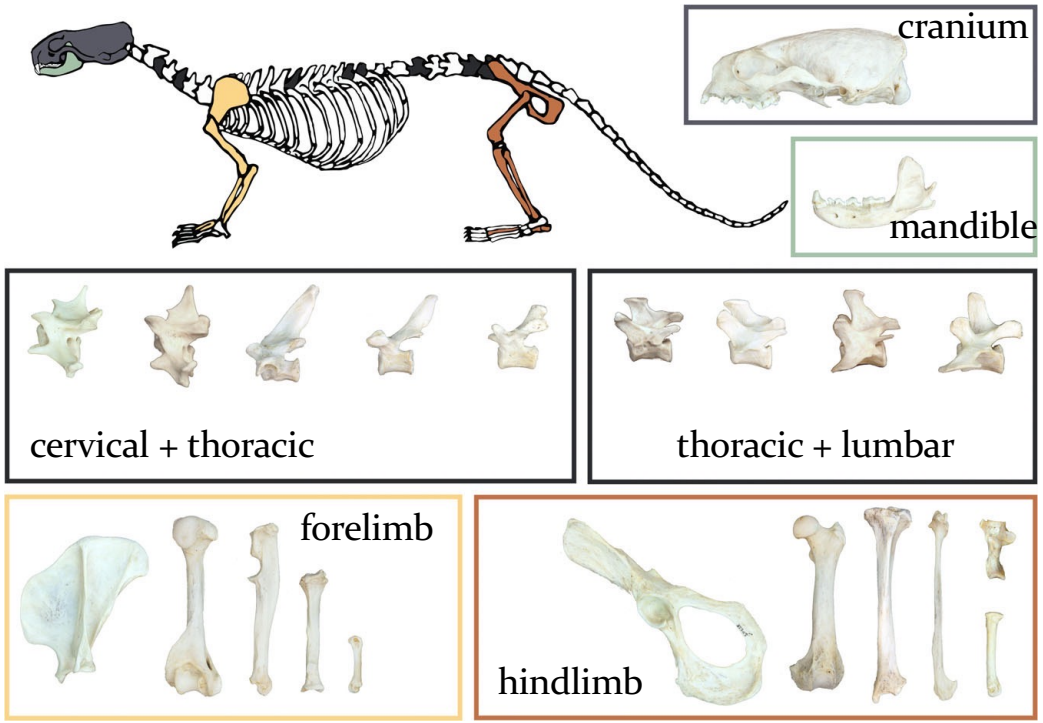
Mosaic versus concerted evolution in grammatical systems

Angela Chira et al

Max Planck Institute for Evolutionary Anthropology

Mosaic evolution

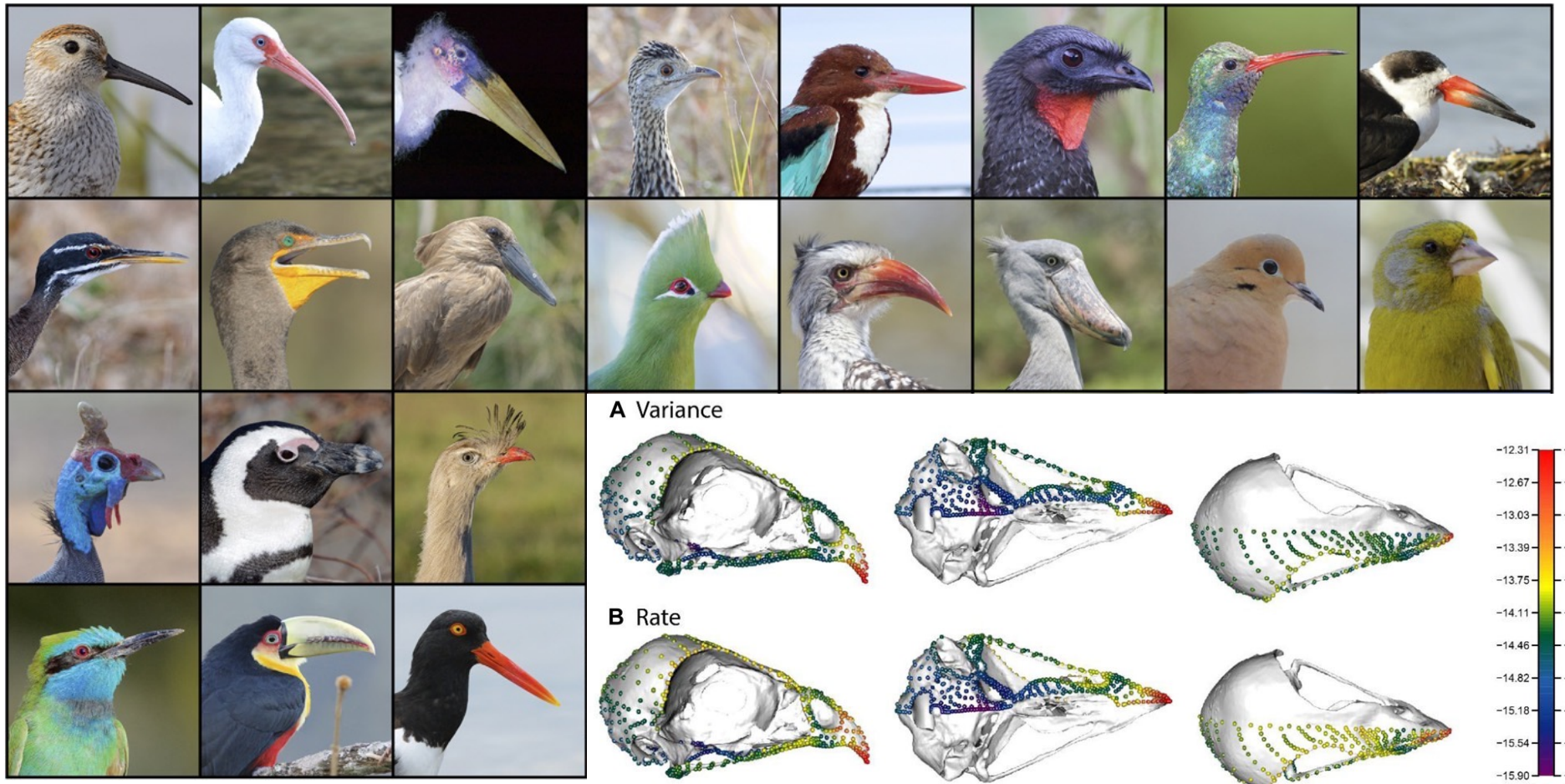
Evolutionary changes do not occur uniformly across the traits of a system



Various skeletal components = semiautonomous modules (Law et al 2024)

Endless skulls most beautiful

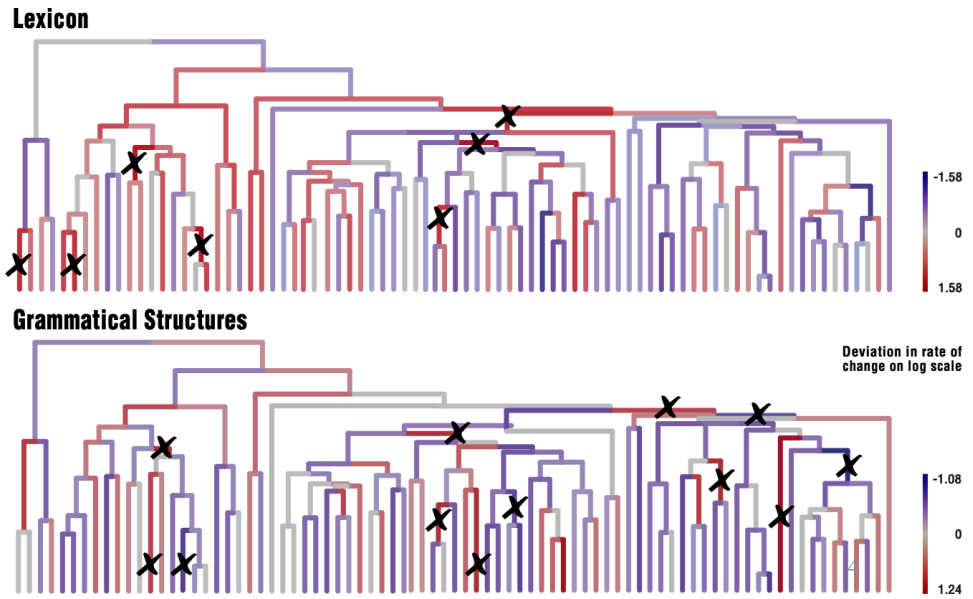
Daniel J. Field[a,1]



Felice et al., 2018 – mosaic evolution in the avian skull

Language & mosaic evolution

- language = complex system of multiple dimensions that change under different selection pressures
- potential for decoupled evolutionary histories

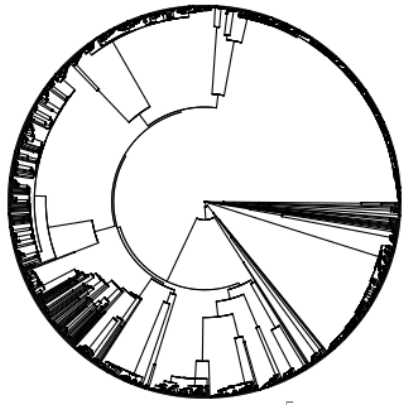


Greenhill et al 2017

Mosaic versus concerted evolution

- grammatical systems
- tree of all extant languages
- focus on rates of change*

  * = episodes of exceptionally rapid/slow change



Grammatical domains

Theory-motivated grammatical indices

word order
locus of marking
fusion
informativity

SCIENCE ADVANCES | RESEARCH ARTICLE

SOCIAL SCIENCES

Grambank reveals the importance of genealogical constraints on linguistic diversity and highlights the impact of language loss

Hedvig Skirgård[1,2,3,4]†*, Hannah J. Haynie[5]†, Damián E. Blasi[1,6,7]†, Harald Hammarström[4,8]†, and 101 others

Grammatical domains

Theory-motivated grammatical indices (Skirgård et al.)

word order: verb-object vs object-verb order

21 features related to order

eg: Mungbam

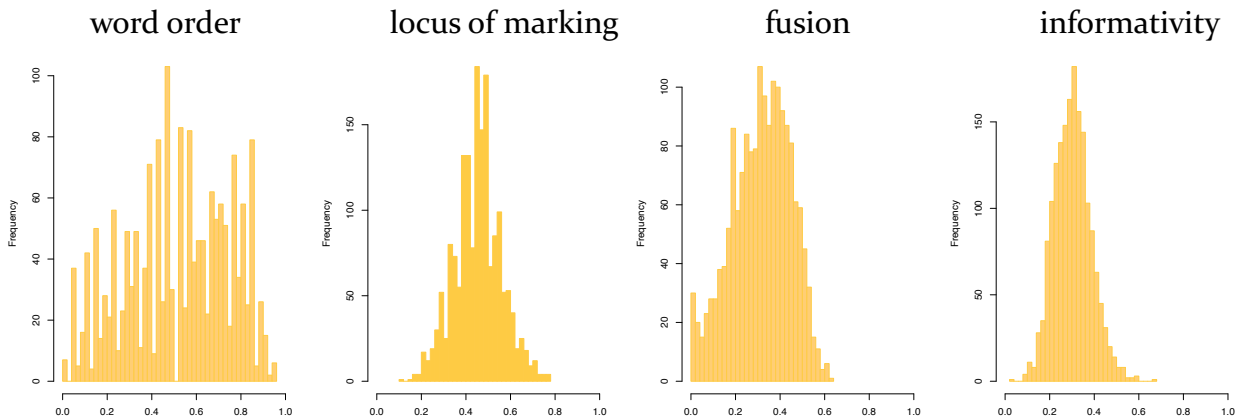
Feature		Original value	Consistent with verb-object?
GB022	Are there prenominal articles?	0	1
GB023	Are there postnominal articles?	1	1
GB074	Are there prepositions?	1	1
GB075	Are there postpositions?	1	0

[…]

Grammatical domains

Theory-motivated grammatical indices (Skirgård et al.)

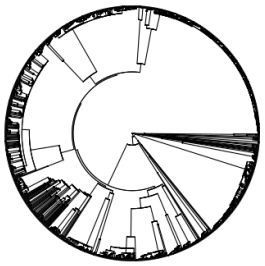
(21) word order: verb-object vs object-verb order
(34) locus of marking: head vs dependent marking
(61) fusion: phonologically bound morphemes vs freestanding words
(73) informativity: tendency of languages to obligatorily encode grammatical functions in their grammar

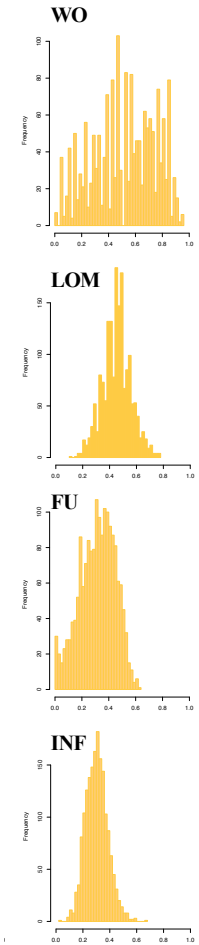


n = 1,716

Mosaic versus concerted

tree + data





SOCIAL SCIENCES

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Global language diversification is linked to socio-ecology and threat status

Bouckaert, R. B.[† 1], Redding, D.[† 2, 3], Sheehan, O.[4,5], Kyritsis, T.[4], Gray, R. D.[4,5], Jones, K.E.[3], Atkinson, Q. D.* [4,6]

Mosaic versus concerted

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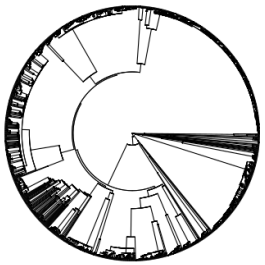
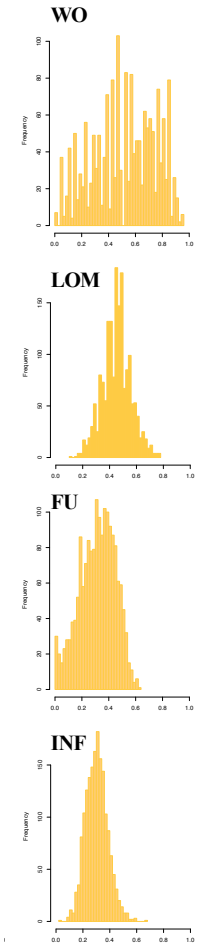


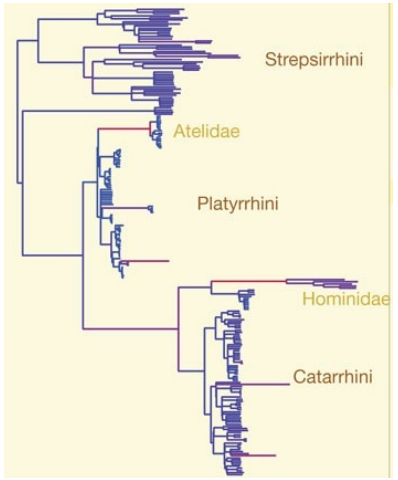


LETTER

doi:10.1038/nature10516

Multiple routes to mammalian diversity

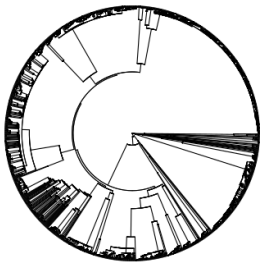
Chris Venditti[1], Andrew Meade[2] & Mark Pagel[2,3]

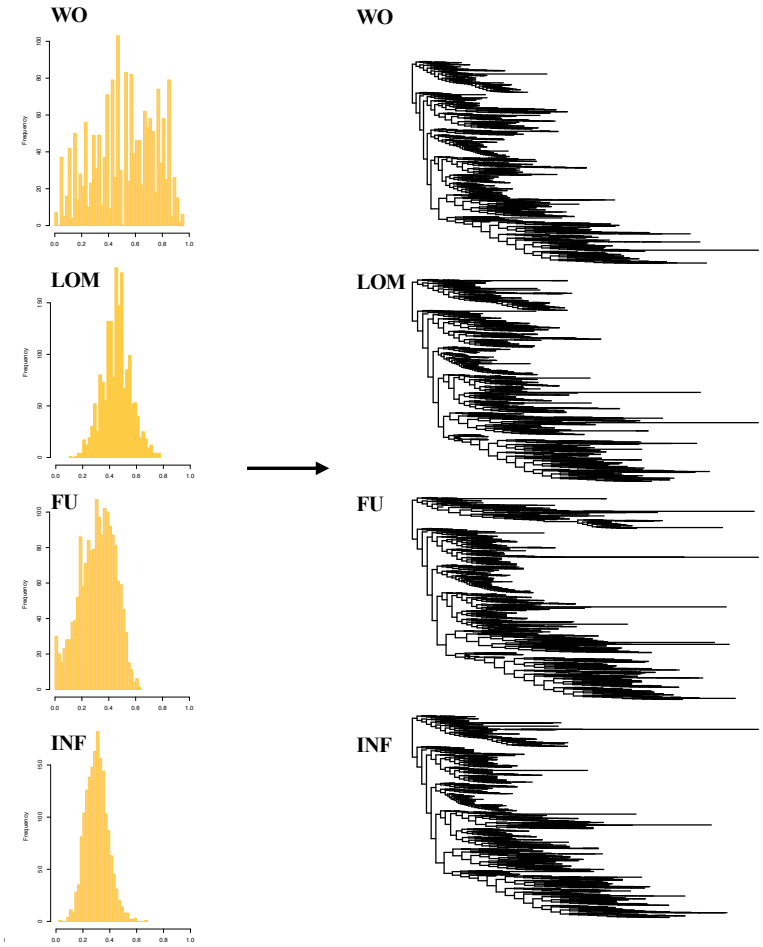


variable-rates model
accounts for rate heterogeneity

Mosaic versus concerted

tree + data





slow/rapid events

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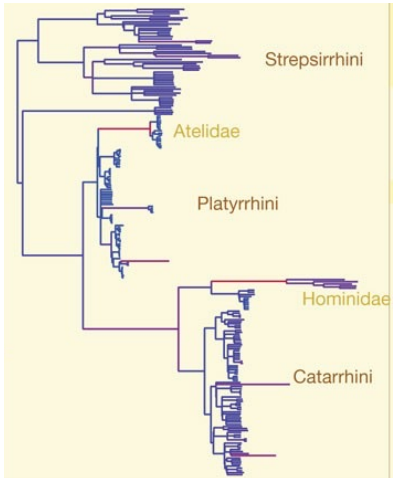
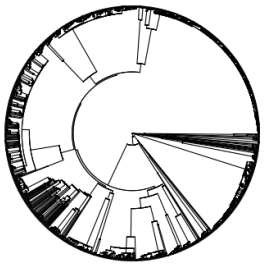


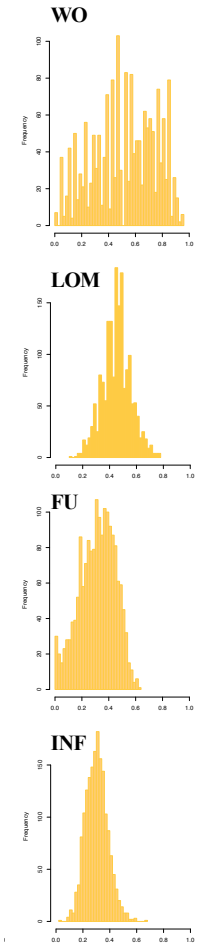
variable-rates model

→ departures from the background

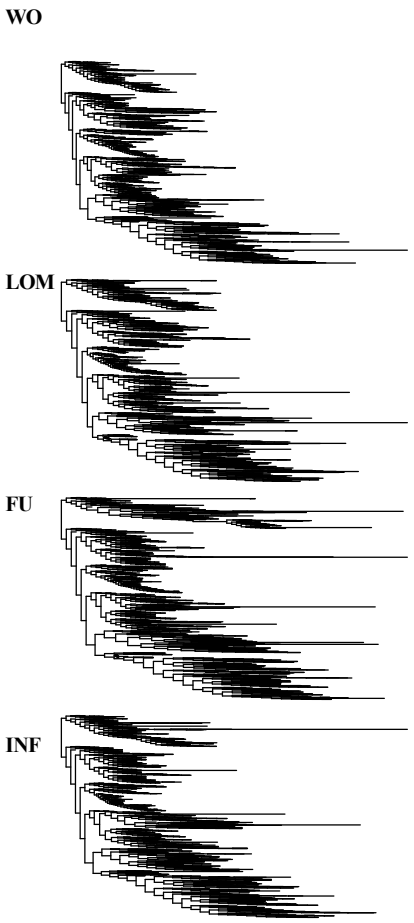
Mosaic versus concerted

tree + data

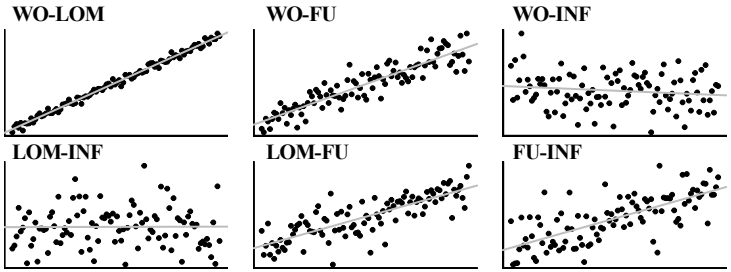




slow/rapid events

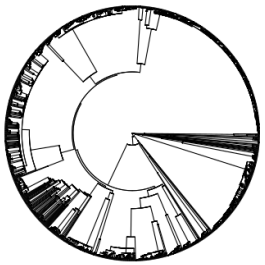


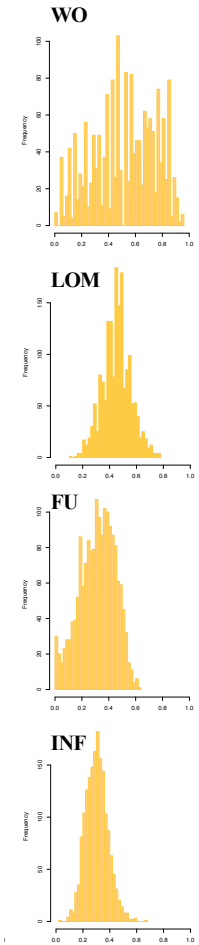
correlated patterns of change



Mosaic versus concerted

tree + data





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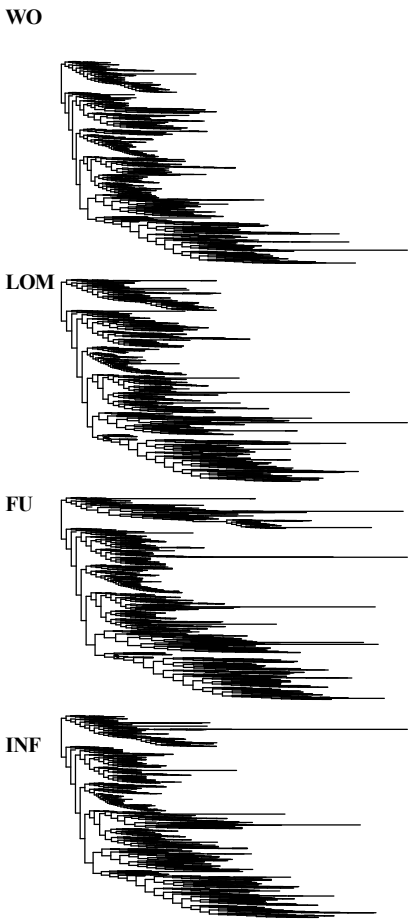

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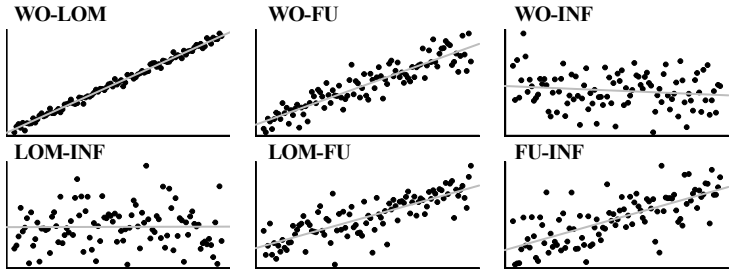
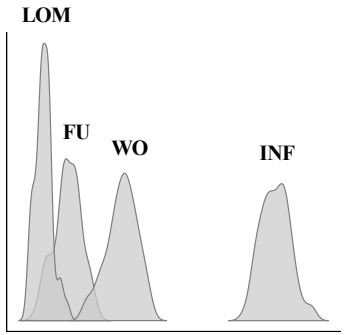
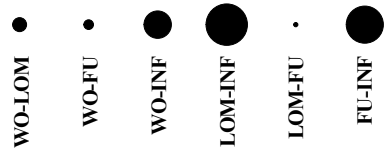


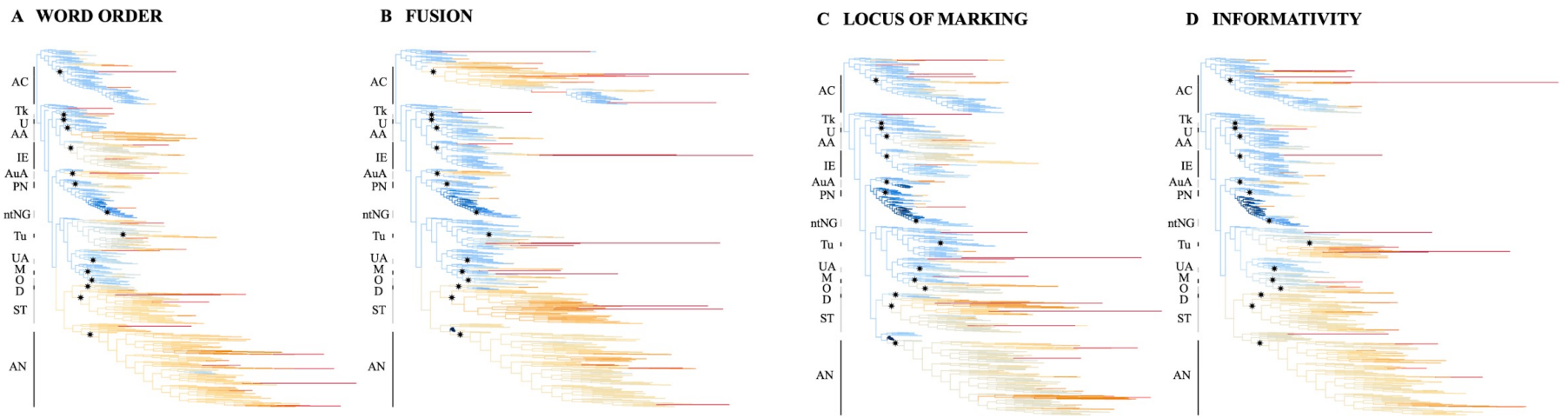
similarities/differences in the magnitude of change





Departures from the background rate

rapid/slow evolutionary events



Major families

Atlantic-Congo (AC)	**Austroasiatic (AuA)**	**Mayan (M)**
Turkic (Tk)	**Pama-Nyungan (PN)**	**Otomanguean (O)**
Uralic (U)	**Nuclear Trans New Guinea (ntNG)**	**Dravidian (D)**
Afro-Asiatic (AA)	**Tupian (Tu)**	**Sino-Tibetan (ST)**
Indo-European (IE)	**Uto-Aztecan (UA)**	**Austronesian (AN)**

Departures from the background rate

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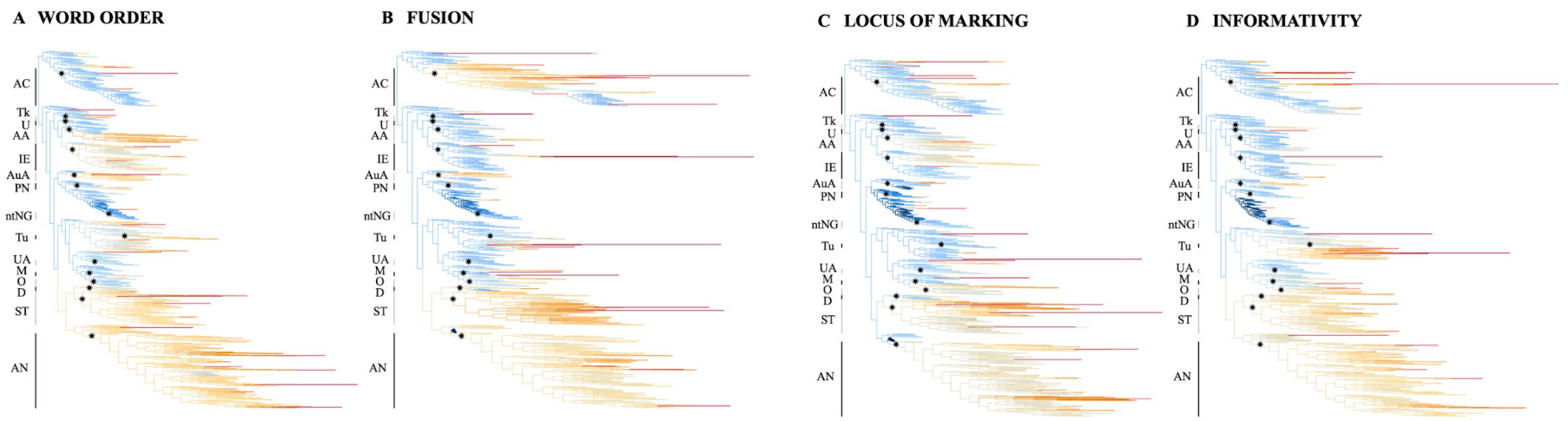

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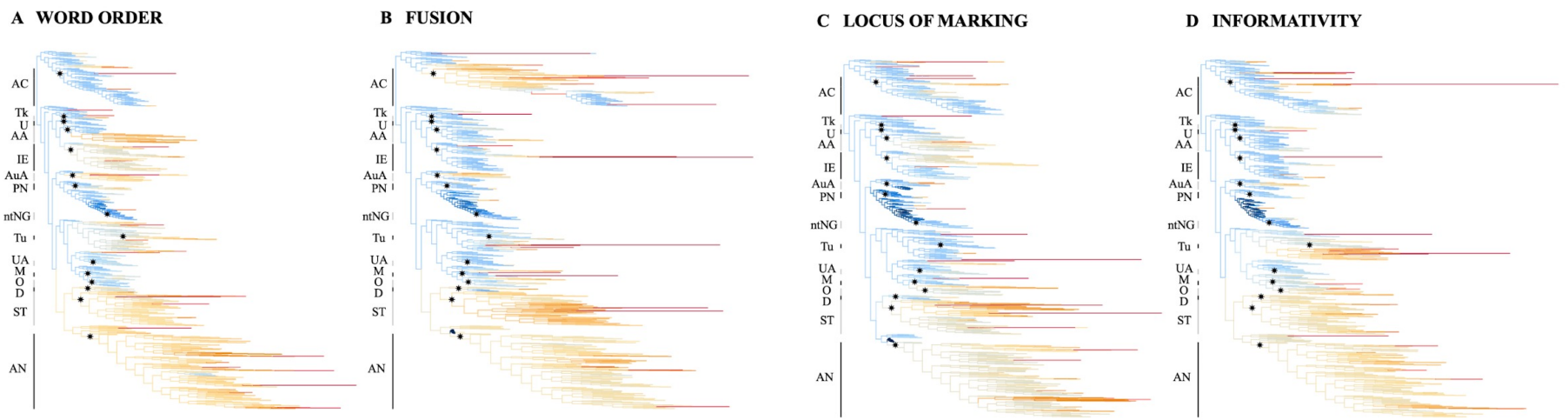
- extensive heterogeneity
- variation among families

Departures from the background rate

rapid/slow evolutionary events



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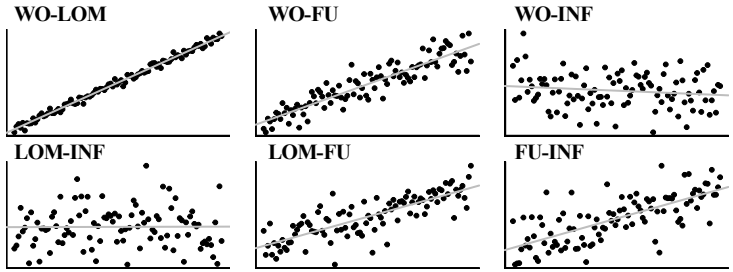
- grammatical domains can show decoupled patterns

extent of mosaic vs concerted?

Correlated patterns of grammatical change

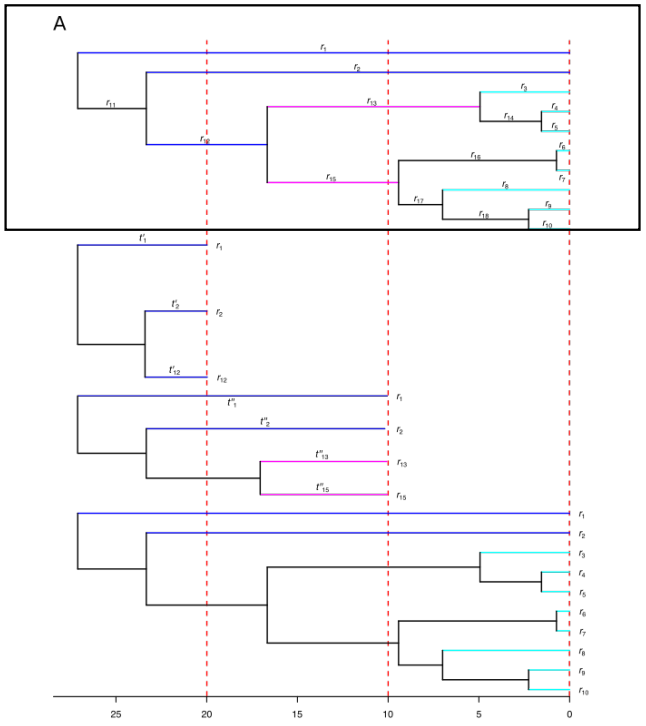
correlated patterns of change



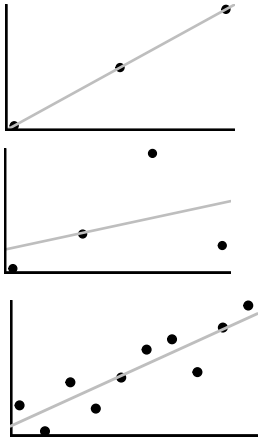
similarities/differences in the magnitude of change

Correlated patterns of grammatical change

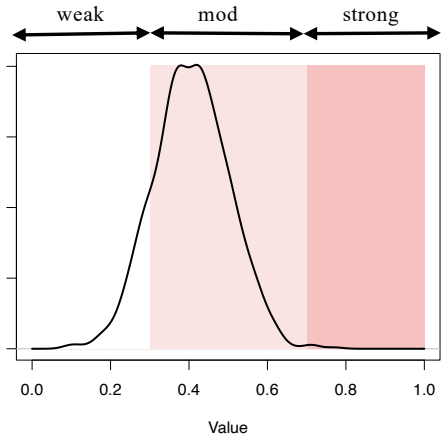
Do grammatical dimensions change together?



correlations
at each time point



distribution of correlation values
at different time points



Sakamoto and Venditti 2018

Total: 6 distributions
WO-LOM, WO-FU, WO-INF, LOM-INF, LOM-FU, FU-INF

Correlated patterns of grammatical change

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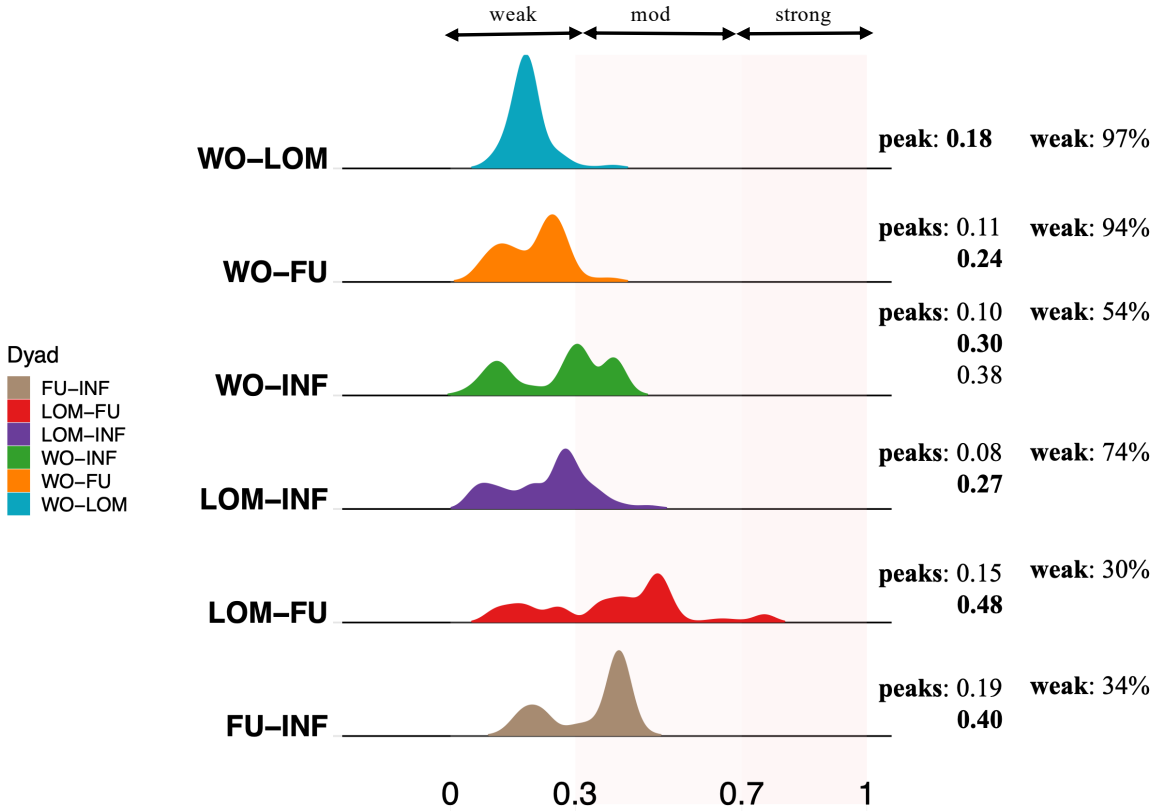
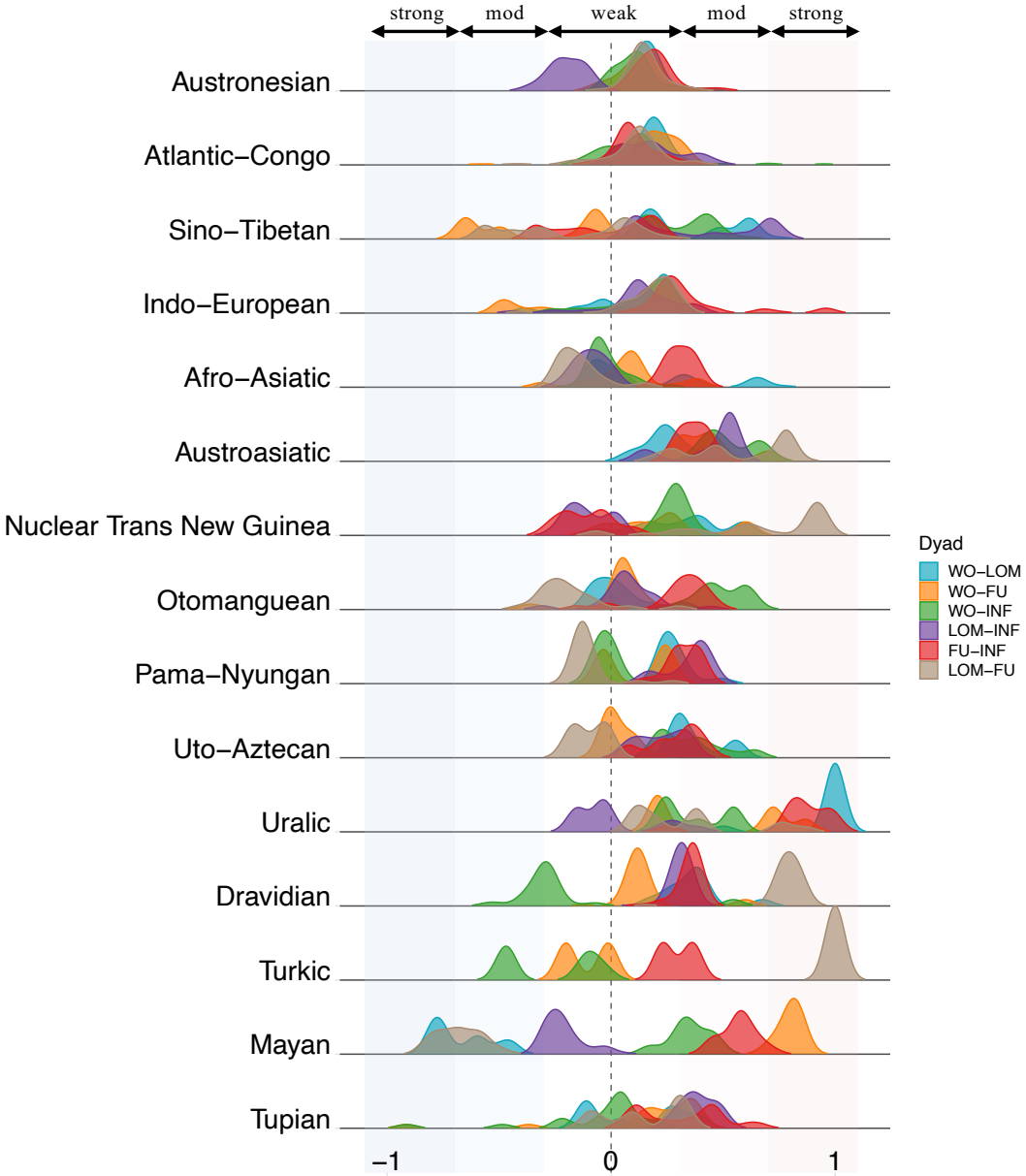


- higher prevalence of weak correlations
- mosaic vs concerted varies among pairs of indices
- variation among dyads

Correlated patterns of grammatical change

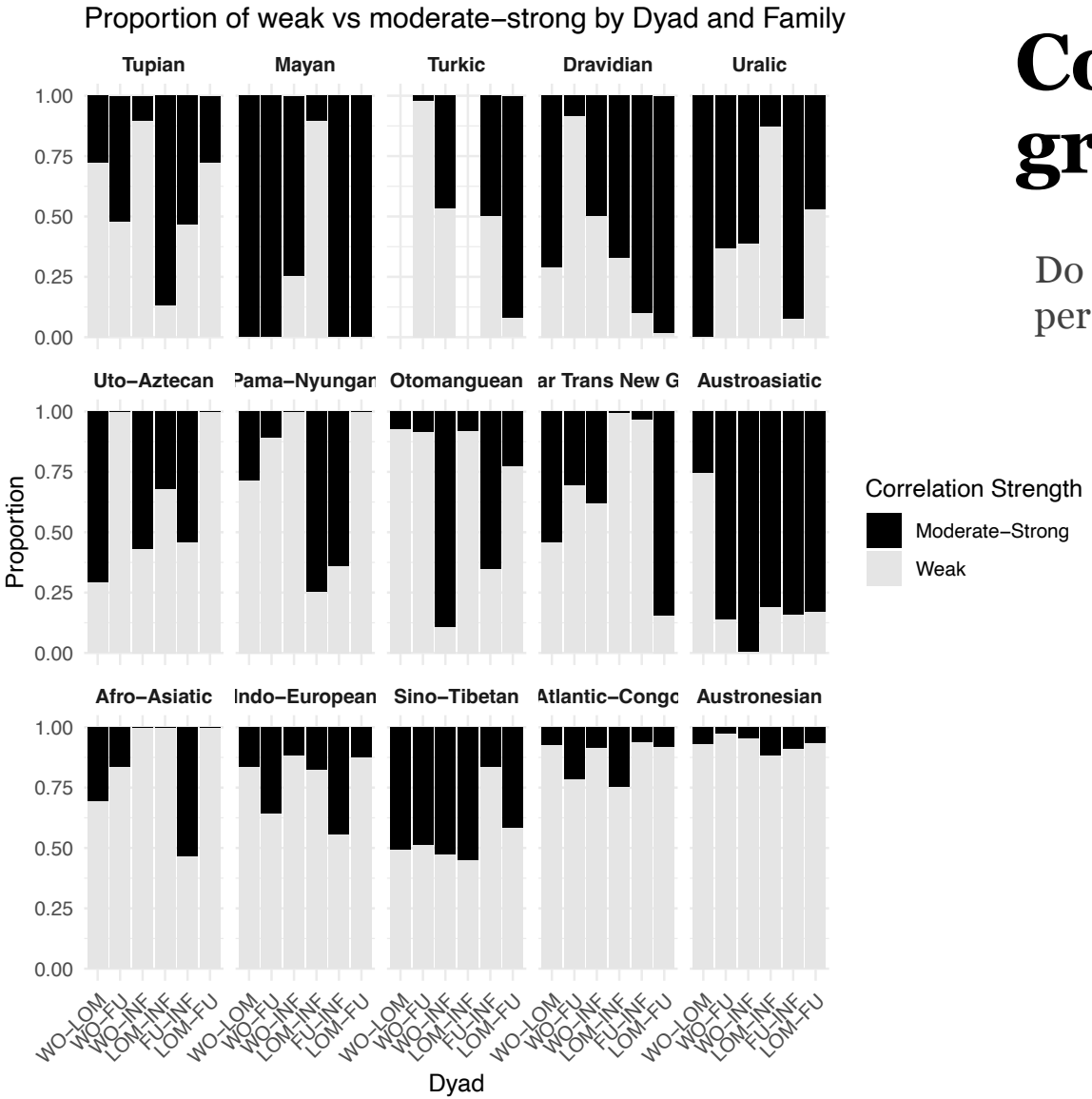
Do grammatical dimensions change together?
per family analysis



Correlated patterns of grammatical change

Do grammatical dimensions change together?
per family analysis

- more variability in the strength of correlations
- higher prevalence of weak correlations BUT sizeable occurrence of concerted too



Correlated patterns of grammatical change

Do grammatical dimensions change together?
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Correlated patterns of grammatical change

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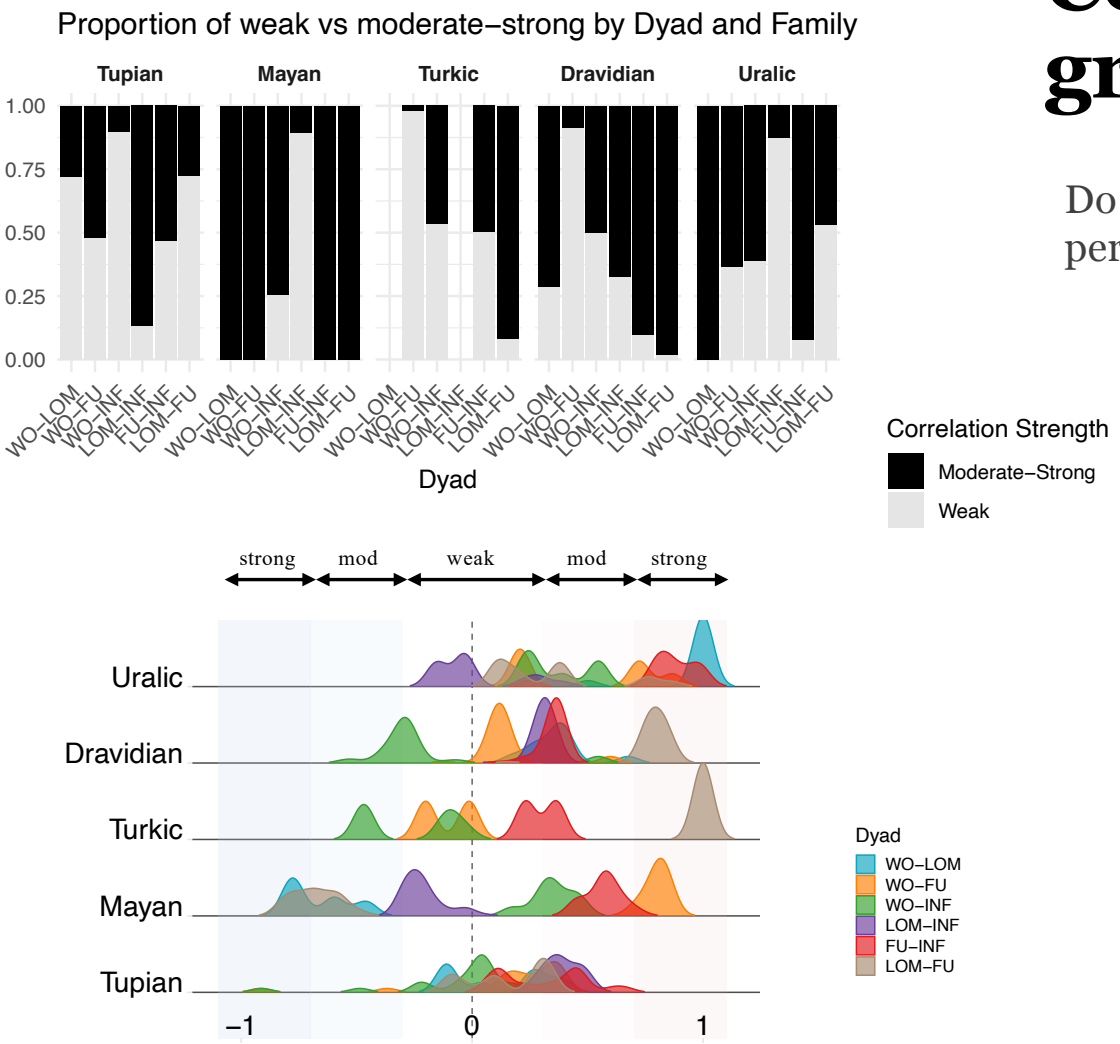
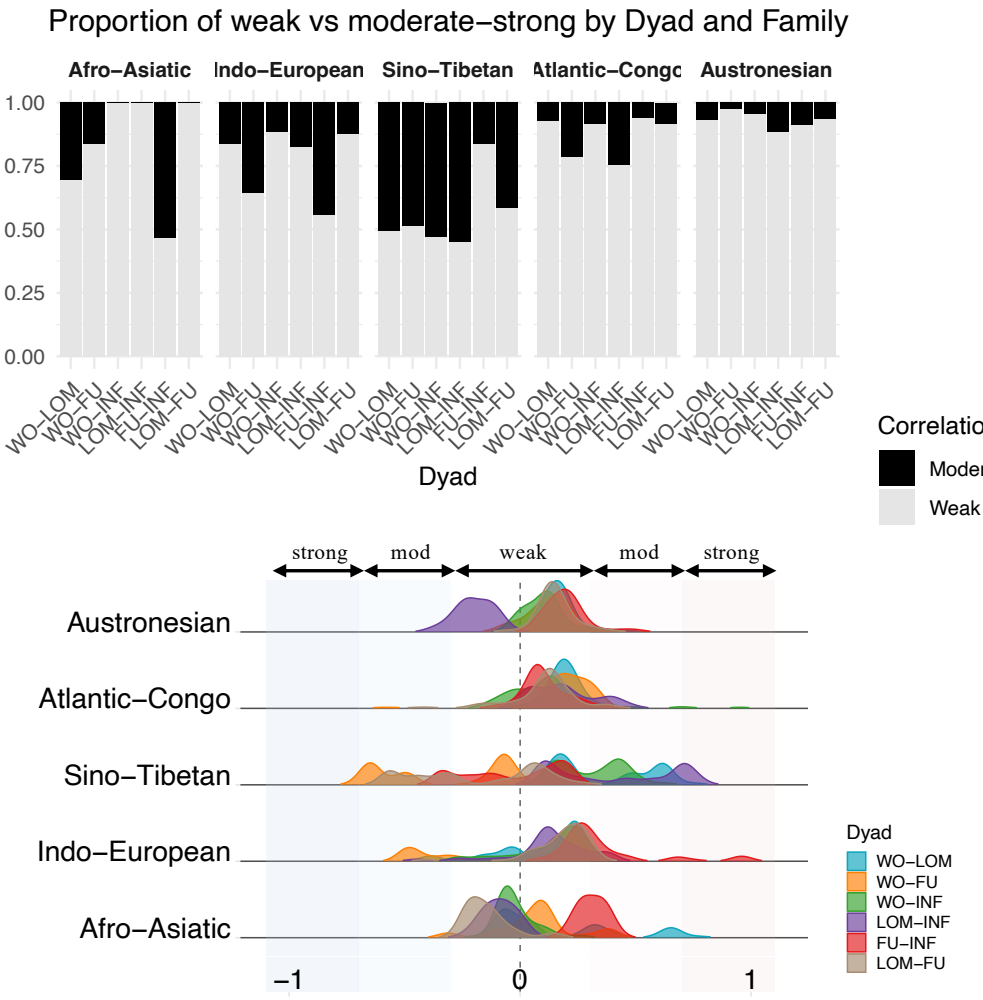
per family analysis



- more variability in the strength of correlations
- higher prevalence of weak correlations BUT sizeable occurrence of concerted too
- variation with family size

Correlated patterns of grammatical change

Do grammatical dimensions change together?
per family analysis

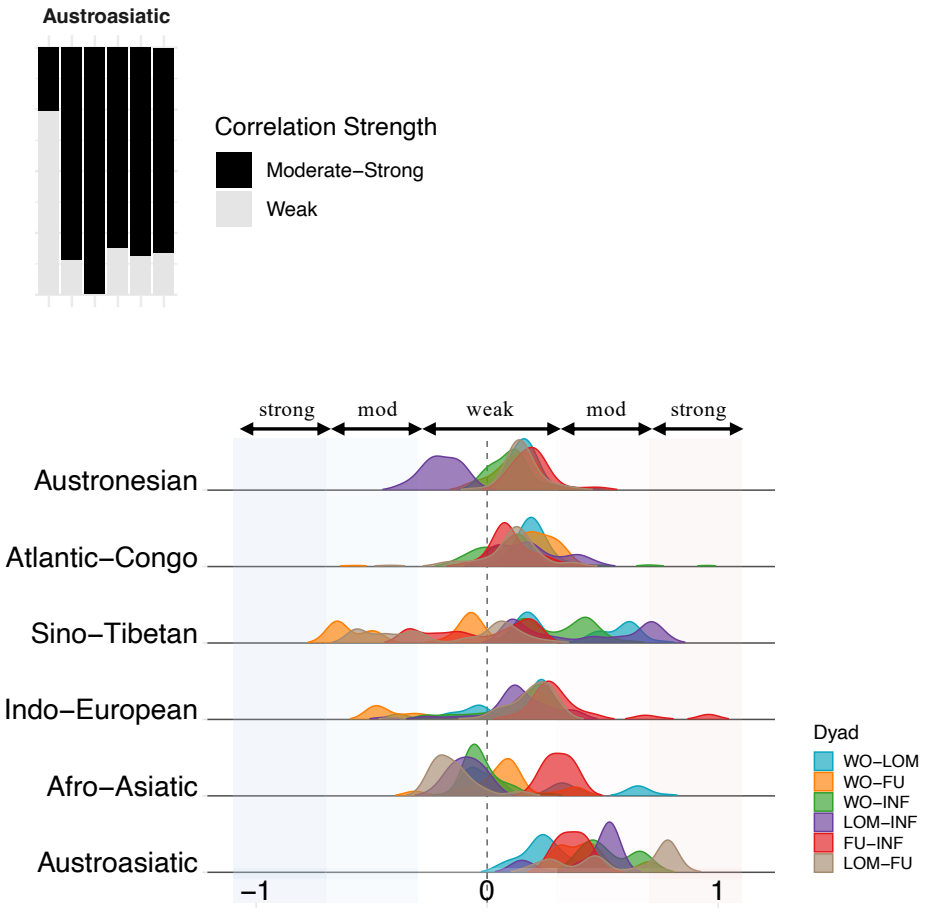


- more variability in the strength of correlations
- higher prevalence of weak correlations BUT sizeable occurrence of concerted too
- variation with family size
  - + family/lineage specific processes

Correlated patterns of grammatical change

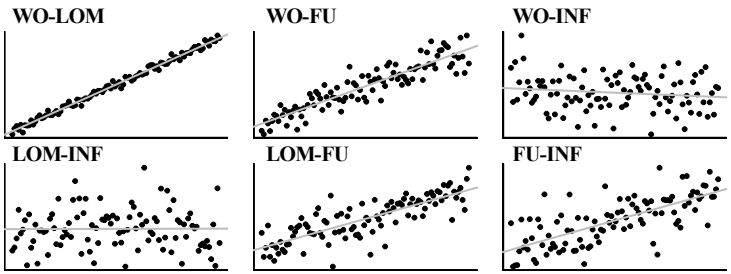
Do grammatical dimensions change together?
per family analysis

- more variability in the strength of correlations
- higher prevalence of weak correlations BUT sizeable occurrence of concerted too
- variation with family size
  - + family/lineage specific processes



Correlated patterns of grammatical change

correlated patterns of change



Do grammatical dimensions change together?

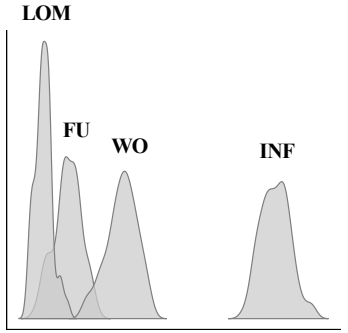
- mosaic evolution and decoupled evo trajectories are common
- the extent of mosaic vs concerted is modulated by functional dependencies, family size, and lineage-specific influences

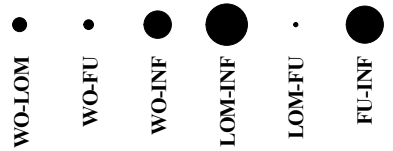
similarities/differences in the magnitude of change

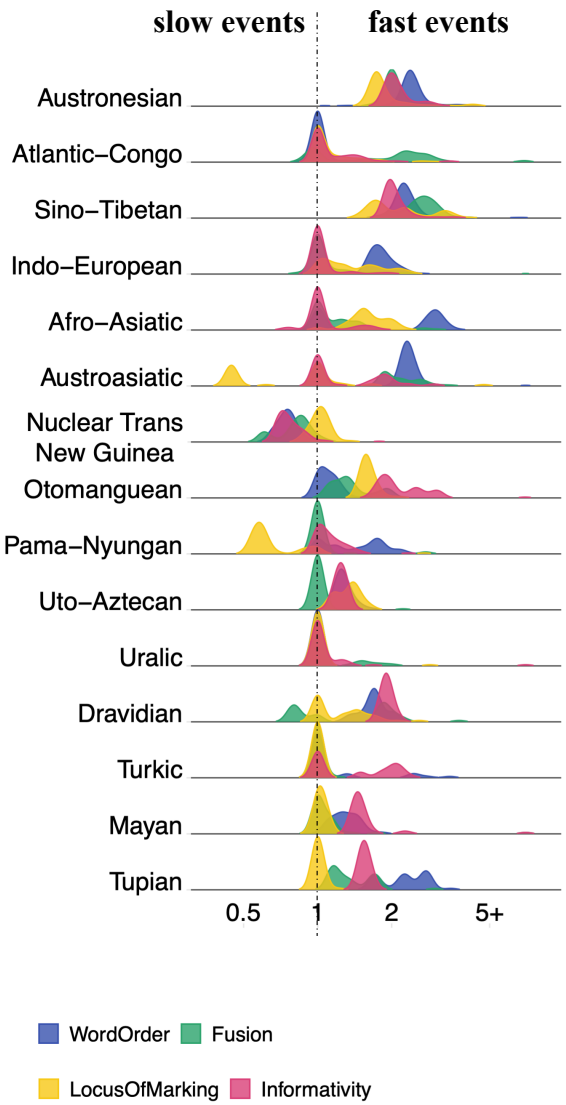
The magnitude of changes

correlated patterns of change

similarities/differences in the magnitude of change

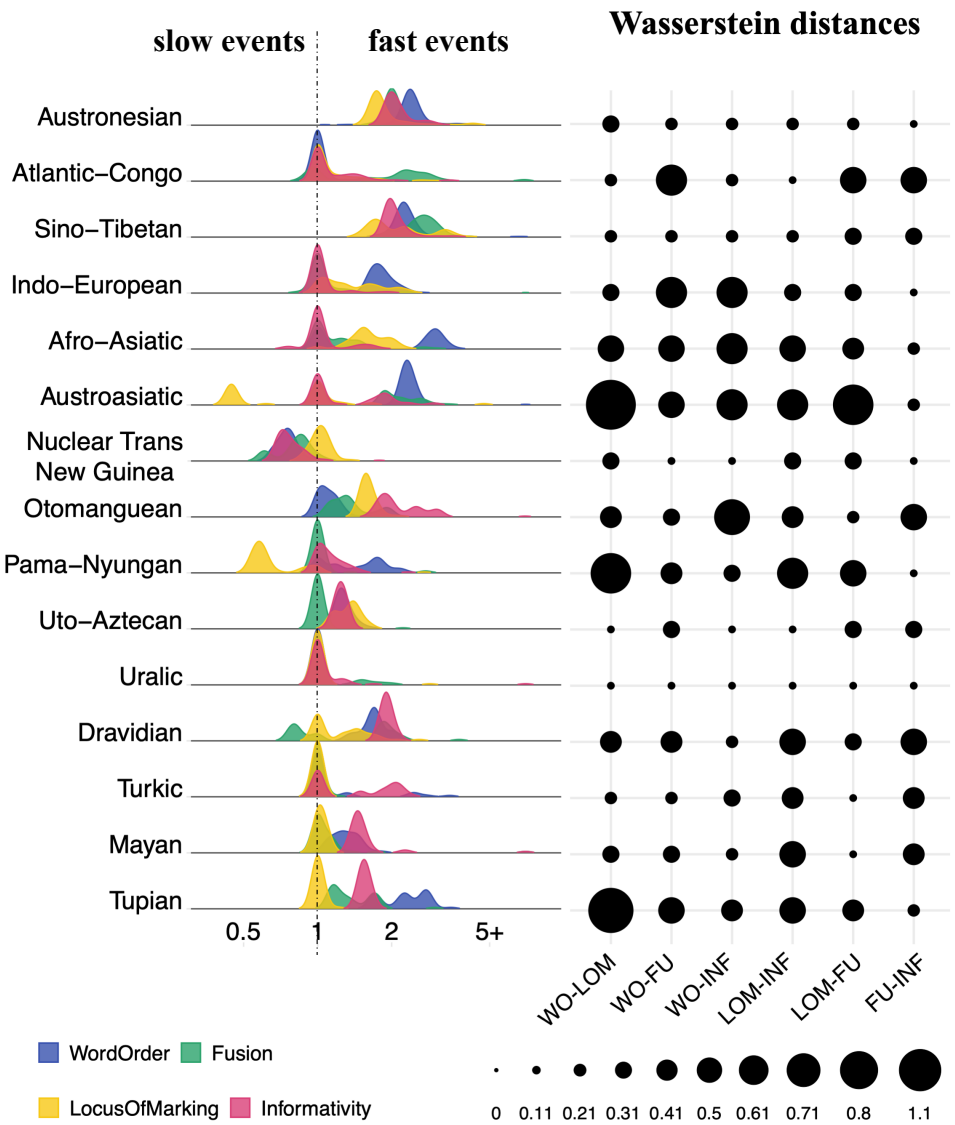






The magnitude of changes

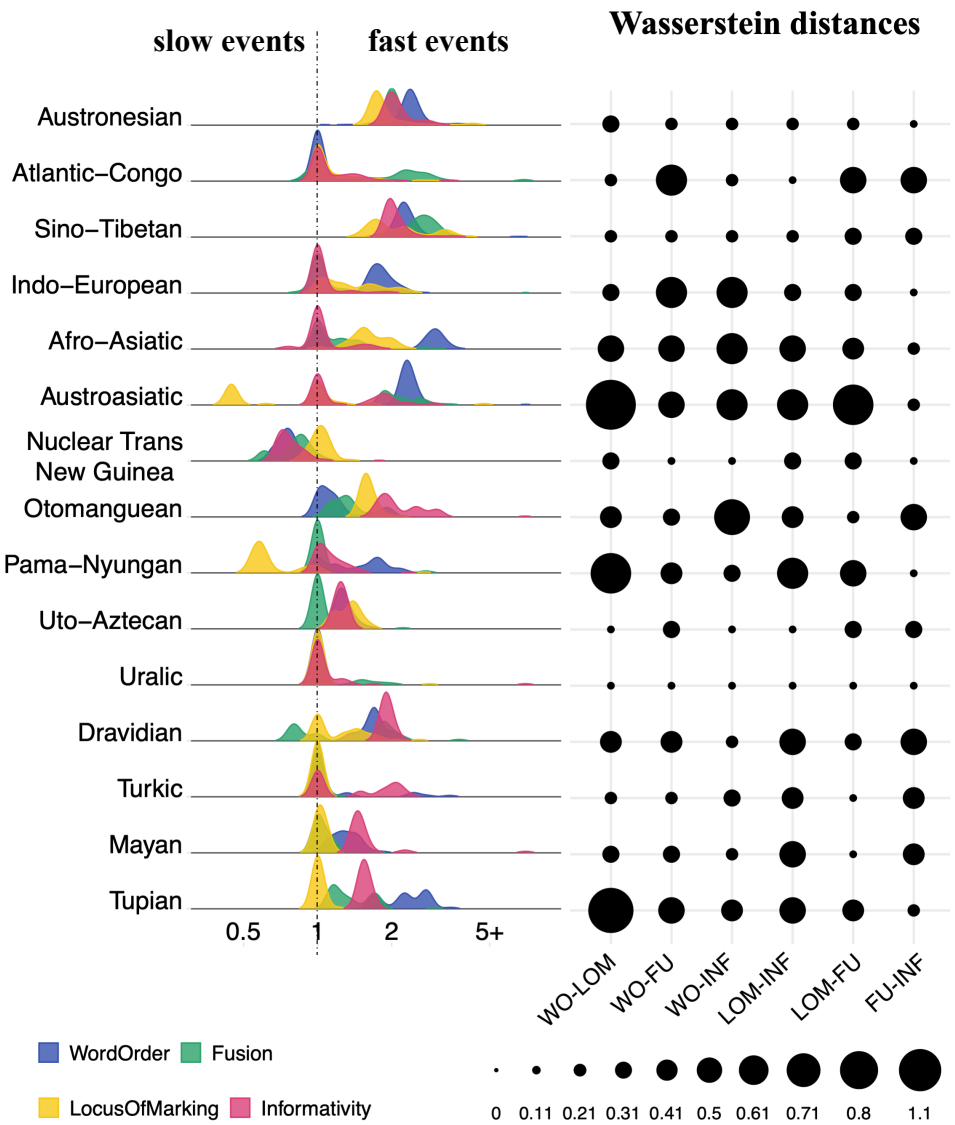
Similarities and differences in the magnitude of change



The magnitude of changes

Similarities and differences in the magnitude of change

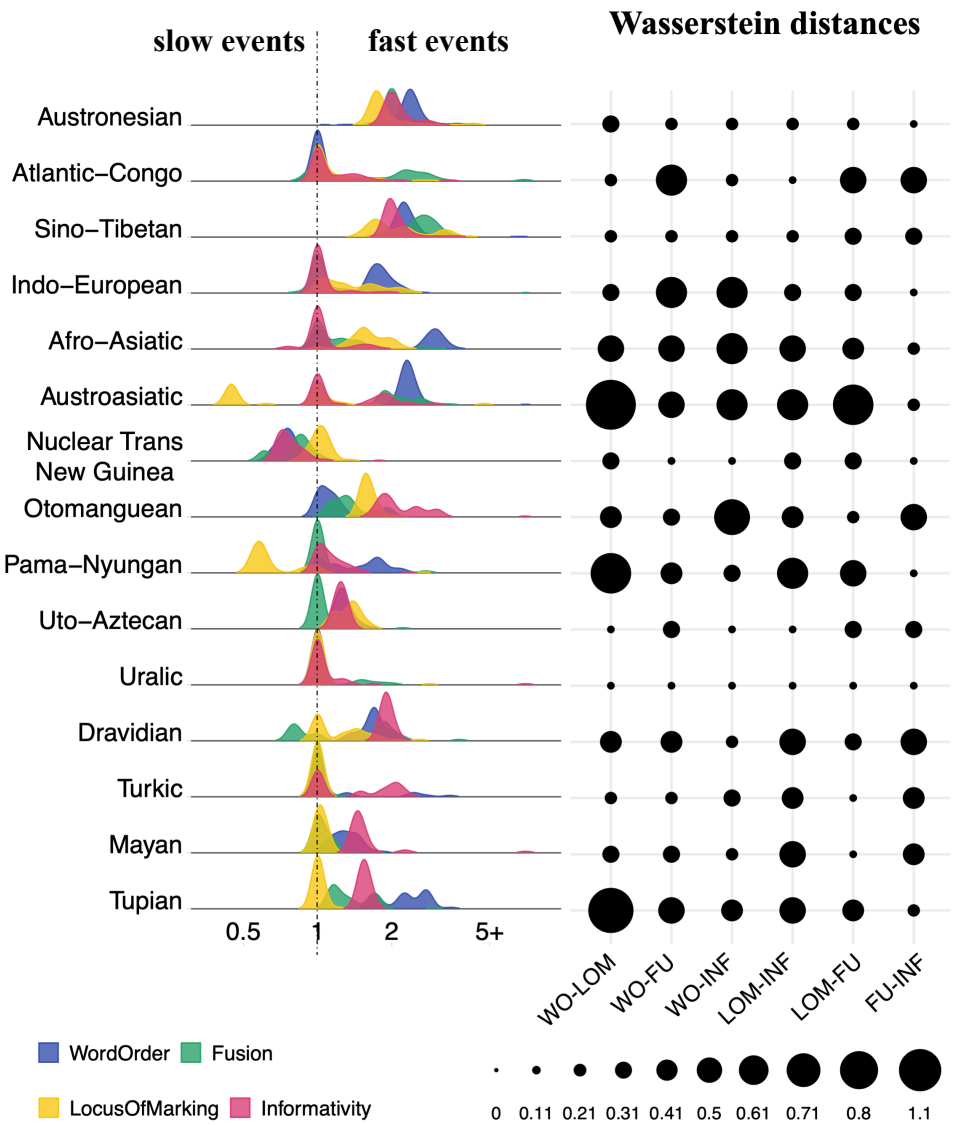
- concerted:
  - Uralic
  - Austronesian
  - Uto-Aztecan
  - Nuclear Trans New Guinea
  - Sino-Tibetan



The magnitude of changes

Similarities and differences in the magnitude of change

- concerted:
  - Uralic
  - Austronesian
  - Uto-Aztecan
  - Nuclear Trans New Guinea
  - Sino-Tibetan
- large families – generalised bursts of evolution

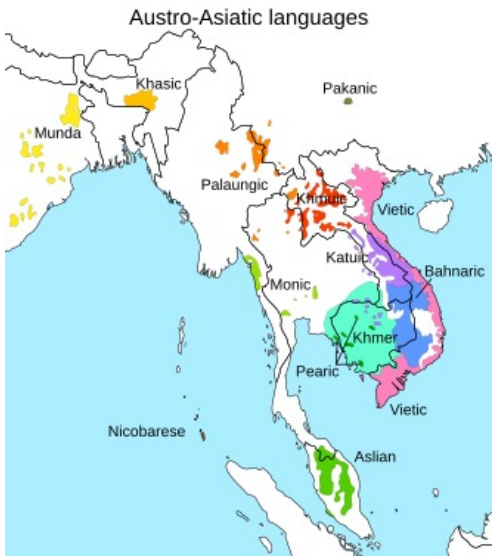


The magnitude of changes

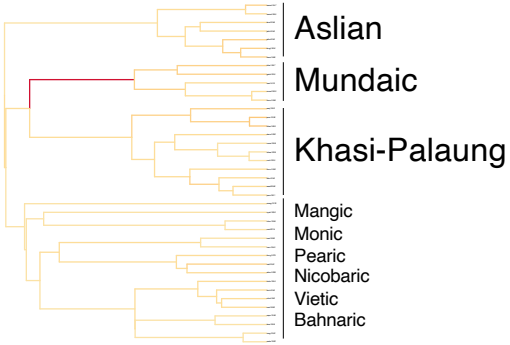
Similarities and differences in the magnitude of change

- mosaic:
  - Austroasiatic
  - Otomanguean
  - Afro-Asiatic
  - Pama-Nyungan
  - Tupian
- Austroasiatic : moderately correlated processes of very different magnitudes

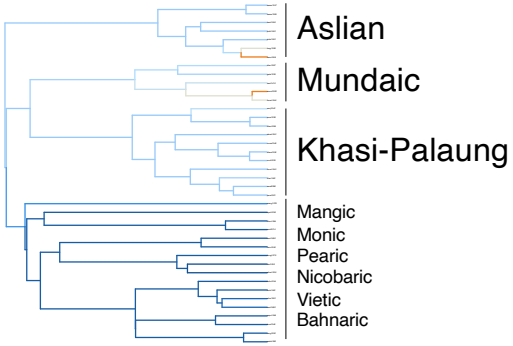
Austroasiatic: moderately correlated episodes of change of very different magnitudes



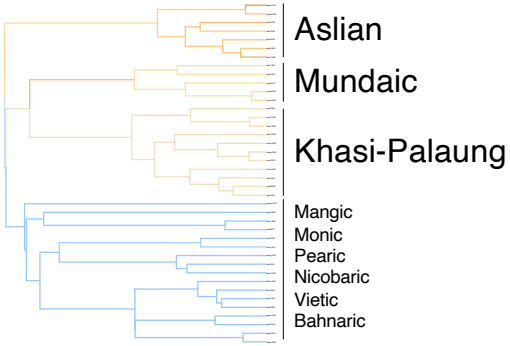
Word order



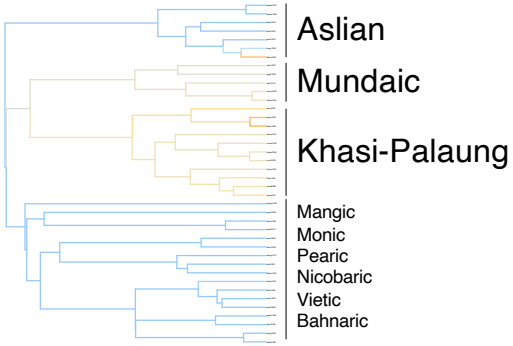
Locus of marking



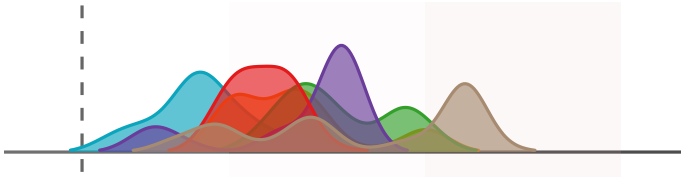
Fusion



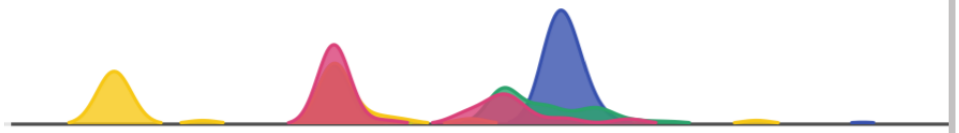
Informativity



moderate correlations



different magnitudes



Mosaic versus concerted evolution in grammatical systems

- weak correlated change (mosaicism) is prevalent, though we see a sizeable occurrence of concerted patterns within families
- differences in the magnitude of change are common
- extent of concerted versus mosaic evolution: modulated by:

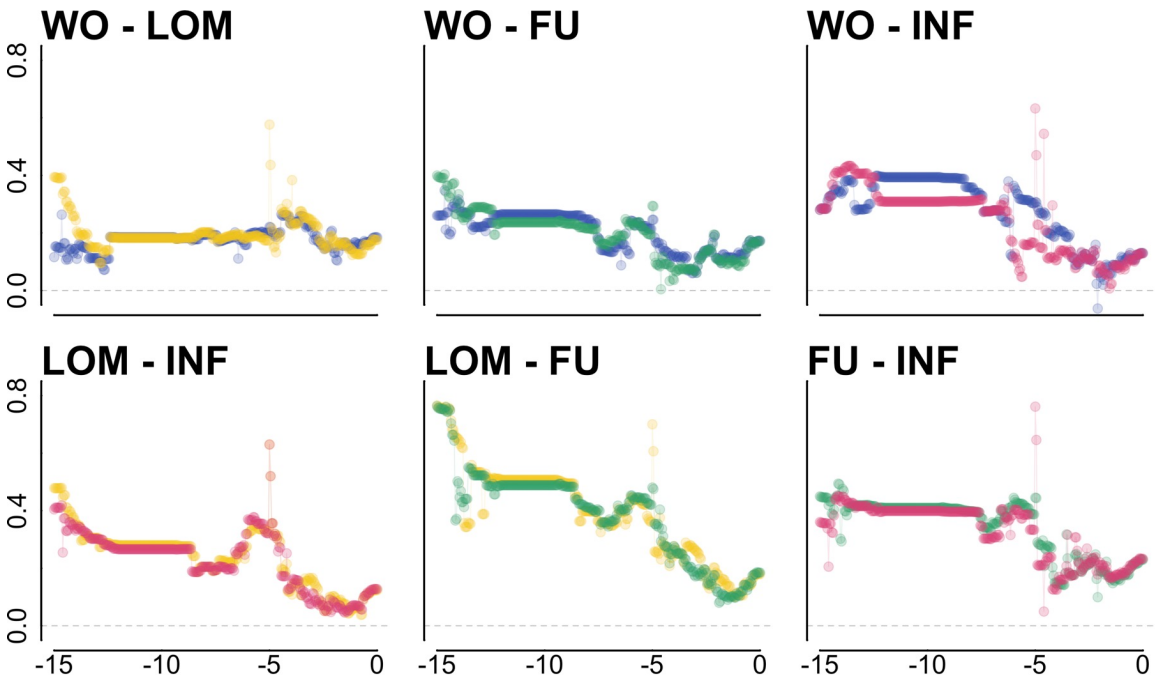
  broad factors like the functional dependence of grammatical domains or factors associated with the proliferation of large language families

  + context-specific influences (families' unique histories)

Thank you!

Correlated patterns of grammatical change

Do grammatical dimensions change together?



Lambdas used

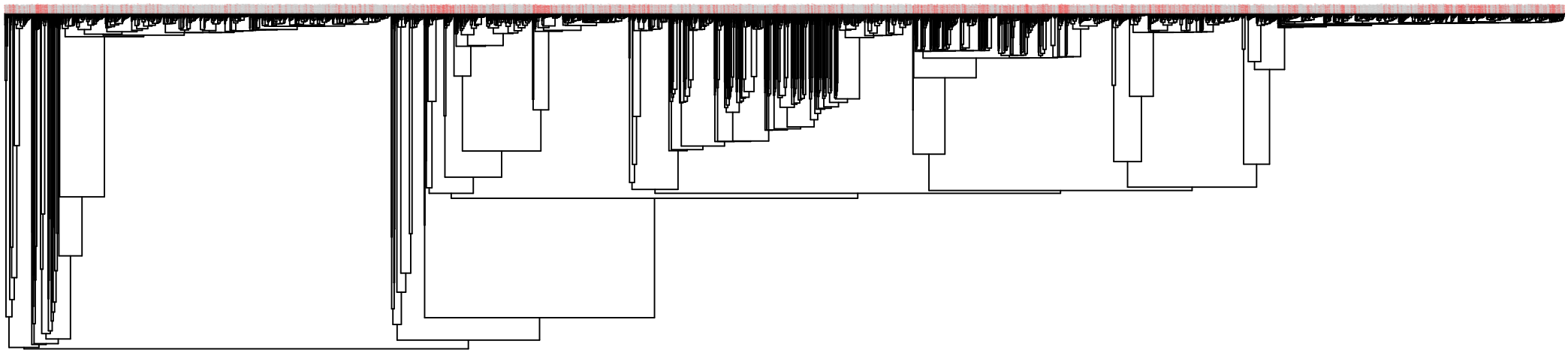
ƛ Word order

ƛ Locus of marking

ƛ Fusion

ƛ Informativity

Tree of all extant languages versus analyses



Sample N = 1,716
In fams: 69%
Outside fams 31%
(fams = bigger than 20)