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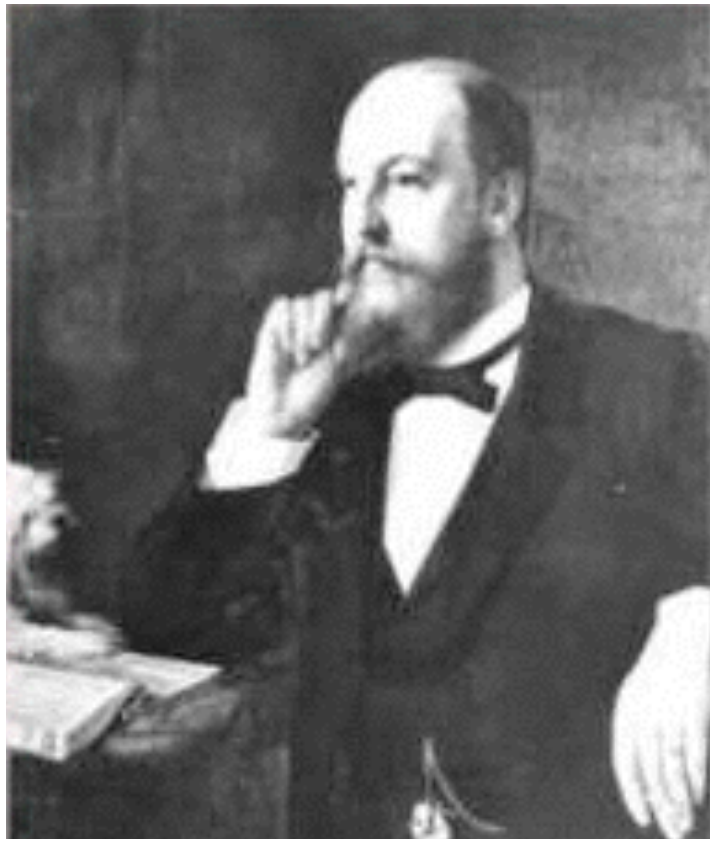
Beyond universals: exploring the conditions of language

Balthasar Bickel

‘God particles’ of human language?

How about the elements that are found in all and only human languages?

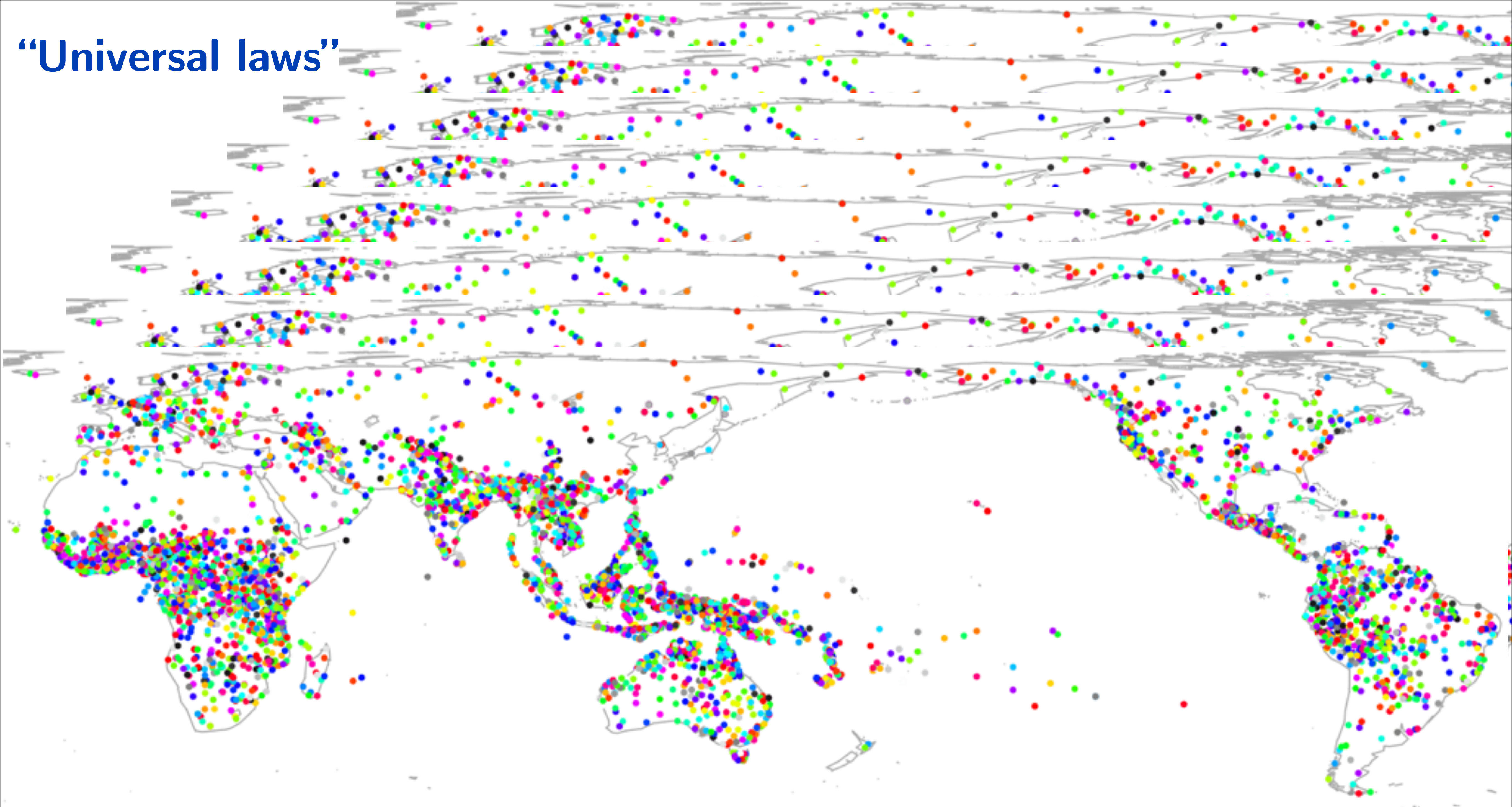
The classical typological answer: search for exceptionless universals



«[W]elcher Gewinn wäre es auch, wenn wir einer Sprache auf den Kopf zusagen dürften: **Du hast das und das Einzelmerkmal, folglich hast du die und die weiteren Eigenschaften und den und den Gesamtcharakter!** - wenn wir, wie es kühne Botaniker wohl versucht haben, aus dem Lindenblatte den Lindenbaum konstruieren könnten. Dürfte man ein ungeborenes Kind taufen, ich würde den Namen Typologie wählen.» (von der Gabelentz 1891:481)

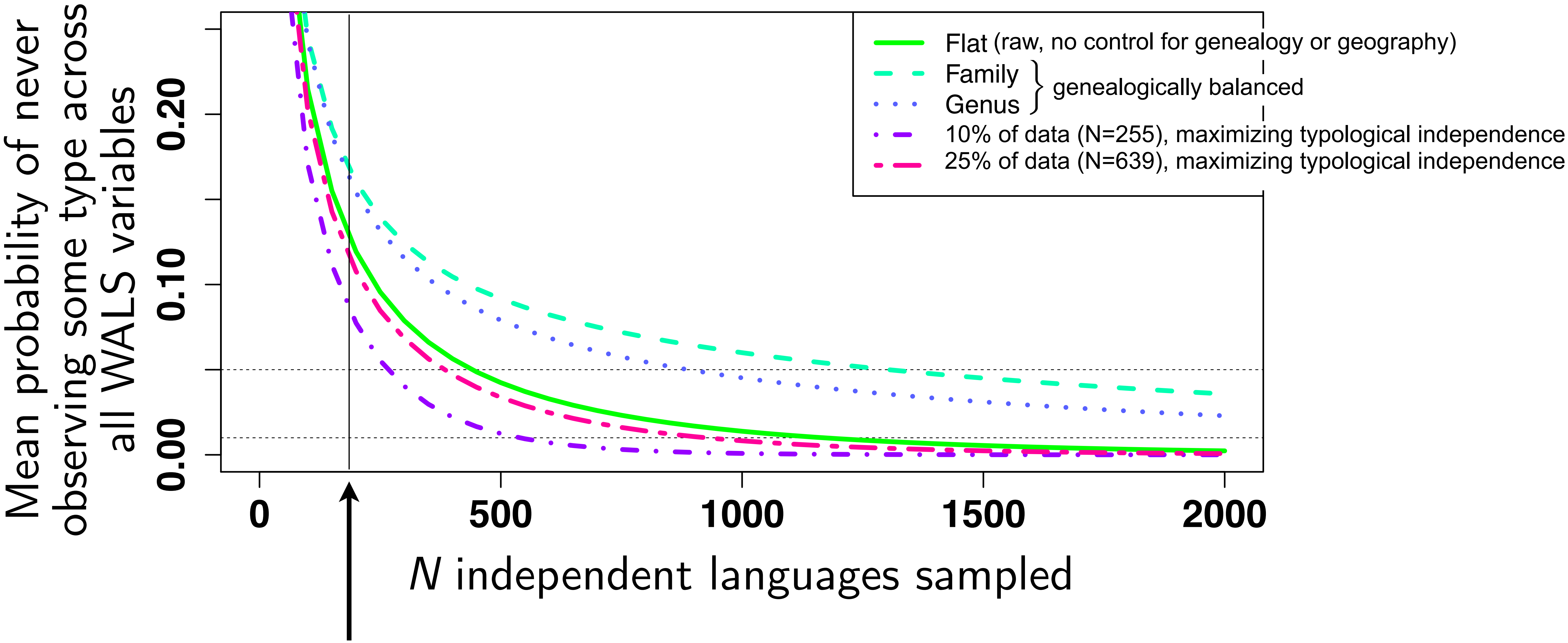
"But what an achievement it would be were we able to confront a language and say to it: '**you have such and such a specific property and hence, also such and such further properties and such and such an overall character**' – were we able, as daring botanists have indeed tried, to construct the entire lime tree from its leaf. If one were allowed to baptize an unborn child, I would choose the name typology."

“Universal laws”



Problems with the classical typological answer

- Problem #1: exceptionless in a sample ≠ impossible
- OK, but what if "exceptionless" = never observing in a sample with $p<.05$?
- Piantadosi & Gibson (2013*):



212 language families in WALS; many less areally independent

Cogn Science

And of course we tend to find counterexamples:

- Claim: *Linear order is fixed within grammatical words, or depends on scope.*
  - Counterexample: Chintang (Sino-Tibetan; Bickel et al 2007*)

a-ma-ap-yokt-u-c-e	~	*ma-a-ap-yokt-u-c-e*	~	*ma-ap-a-yokt-u-c-e* etc.
2sA-NEG-shoot-NEG-3P-3ns-PST		NEG-2sA-shoot-NEG-3P-3ns-PST		NEG-shoot-2sg-NEG-3P-3ns-PST

'You didn't shoot them.'

- Claim: *Syntactic ergativity requires morphological ergativity*
  - Counterexample: Oirata (Timor-Alar-Pantar; Donohue & Brown 1999+)

a. *inte* [*ihar* [*mara-n*]] *asi.*
1peNOM dog.NOM go-REL see
'We saw the dog that had left.'

b. [*ihar* [*ante* *asi-n*]] *mara.*
dog.NOM 1sNOM see-REL go
'The dog that I saw.'

c. *[*ihar* [*ani* *asi-n*]] *mara.*
dog 1sACC see-REL go
'The dog that saw me left.'

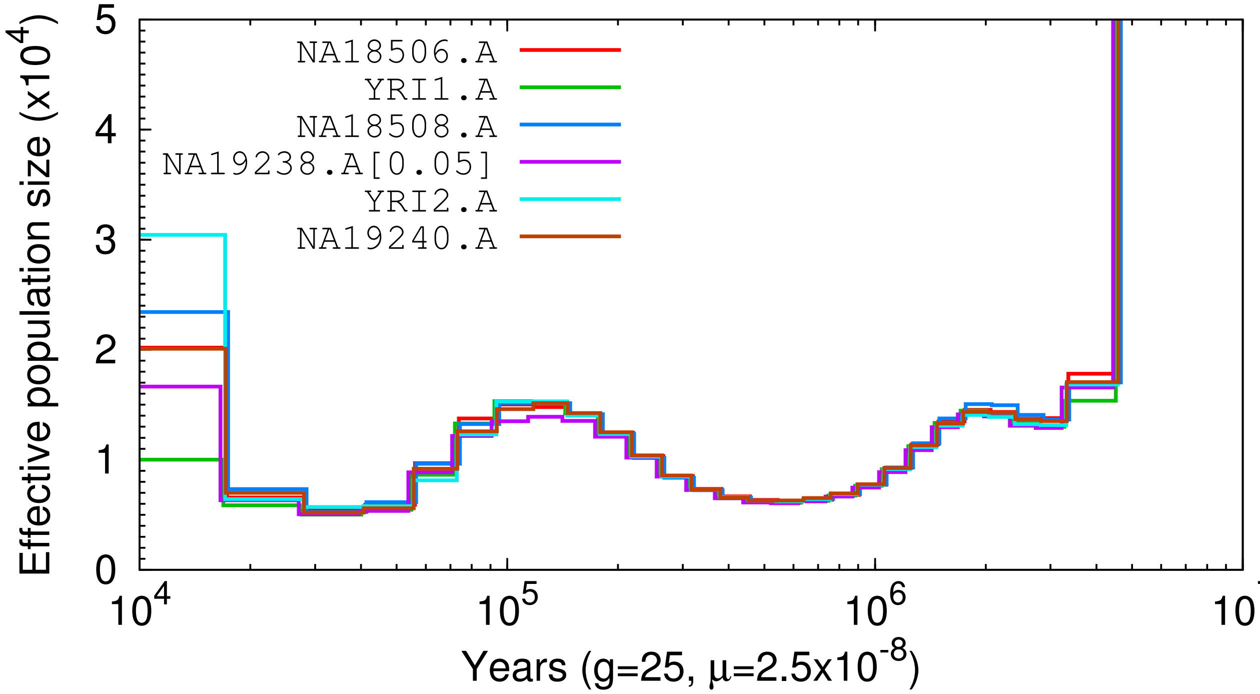
*Language, +Austr J of Ling

Worse: what do our samples represent?

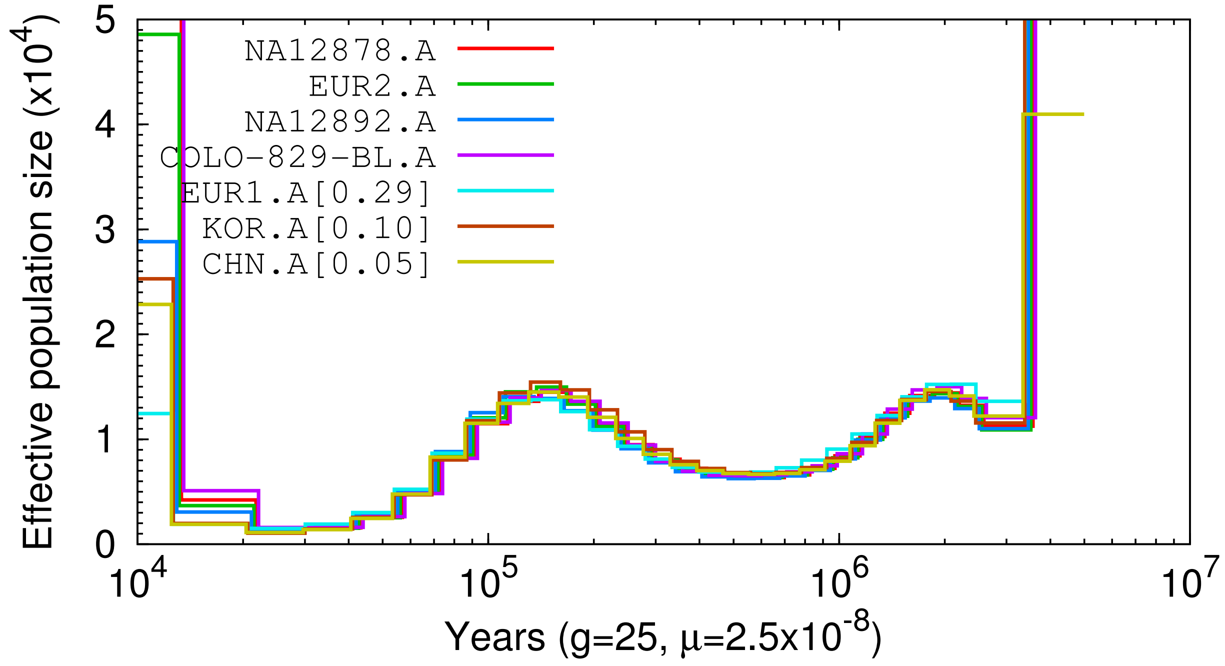
- Unclear which structures survived the population bottlenecks in hour history (cf. Evans & Levinson 2009*, Dediu & Levinson 2013+)

Li & Durbin (2011#):

Autosomes Africa



Autosomes Out-of-Africa



(Estimates based on individual whole-genome sequences)

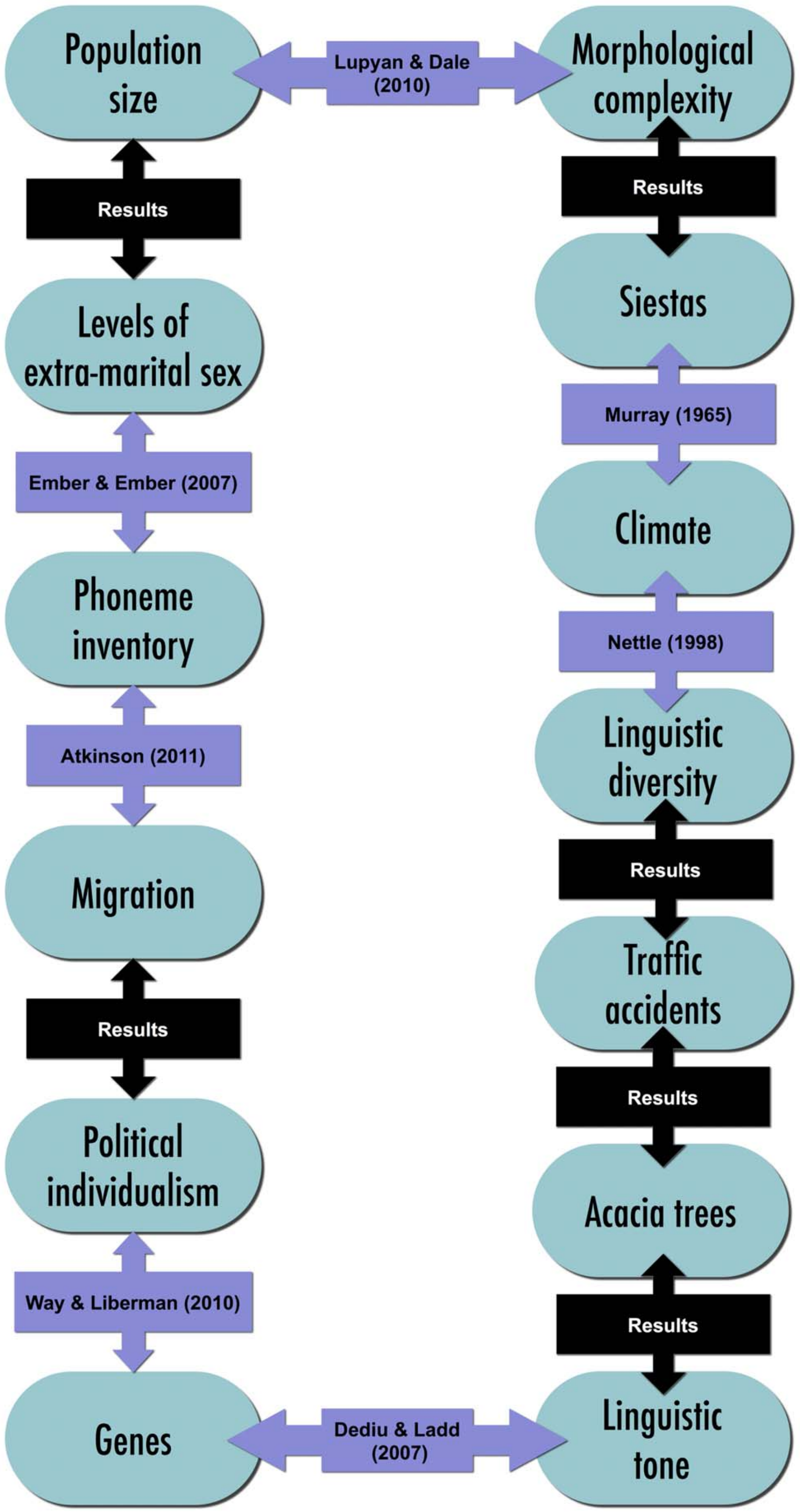
*BBS, +Frontiers in Psych, #Nature

Another problem: potentially spurious correlations

- If agglutinative, then verb-final and simple syllables

  (Konstanz Universals Archive #11, #372)

- If there is case, then there is number (KUA#116)
- If SHAPE as Adj, then COLOR and SIZE as Adj (KUA#141)
- If nouns inflect for case, verbs also inflect (for something) (KUA#228)
- If VO and atonal, then NRel.



(Roberts & Winters 2013*)

So, if exploring samples is not a safe route to exceptionless universals, what to do?

The classical structuralist answer: *guarantee* exceptionless universals!

Pāṇini's Cakra: Formulate a generalization and then explain away counterexamples.

"2.3.1 if not already expressed,

2.3.2 for goal: case 2 (ACC)

2.3.46 for gender and number only (i.e. no role specs): case 1 (NOM)

3.4.69 for agent, goal or intransitive: *laḥ* (finite verb endings)"

- Apply Pāṇini's Cakra to a universal, and you win!

How to guarantee universals with Pāṇini's Cakra

- *Problem:* Lack of phonological syllables in Gokana (Hyman 1983[*])
  - $C_2 \subset C_1$: C_2 only {b, l, g}
  - but differences are defined by words, not syllables:

    C_1V, C_1VV, C_1VC_2, C_1VVV, C_1VVVV

    C_1VC_2V, C_1VVC_2V, C_1VC_2VV, C_1VVC_2VV

- *Solution:* Assume syllables as universals nevertheless but add specific constraints: C_2 only in weak (second) syllables; and derive C_1VC_2 from $[_\sigma\, C_1V][_\sigma\, C_2V]$ (Hyman 2011[+])

> But why not an analysis without syllables?
> `\bCV([blg]|V{1,3}|(V?([blg]V{1,2})?))\b`

*Curr Appr Afr Ling, +Phonology

How to guarantee universals with Pāṇini's Cakra

- *Problem:* Lack of grammatical or phonological words in Vietnamese (Schiering, Hildebrandt & Bickel 2010*):

  (1) Engl. *red* → *redd-ish*, *not reddish*, but: **red-not-ish*

  (2) Vietnamese *đo-đỏ*, *không đo-đỏ*, oder: *đo-không-đỏ*

  or *cà phê* (from French *café*): *cà với phê* 'coffee and the like'

- *Solution:* Assume words as a universal nevertheless (Vogel 2009+), but allow them to be interruptable under specific circumstances.

> But why not assume a variable here?
> Languages with vs. languages without words?

*J of Ling, +Universals of Language Today

How to guarantee universals with Pāṇini's Cakra

- *Problem:* Violations of Greenberg Universal #2 and of the Final-Over-Final Constraint in Harar Oromo (Kushitic, Owens 1985)

[$_{PP}$ [$_{NP}$ *maná* [$_{NP}$ *obbolesá xiyyá*]] =*tt*]

house brother my in

N P

- *Solution:* Limit the FOFC to complements with the same category features (Biberauer et al. 2008*) and argue that Oromo postpositions are [-N], or indeed not postposition at all.

> But why not assume a variable here? So that disharmonic head-final structures are dispreferred but not excluded?

*WCCFL

How to guarantee universals with Pāṇini's Cakra

- *Problem:* lack of nested phrase structures in Pirahã (Everett 2005*, 2009+)

- *Solution:* Assume nested phrase structures as a universal nevertheless and limit embedding to 1 level under specific circumstances (Nevins et al. 2009+).

> But why not assume a variable here? Especially since we know how nested structures can come and go (e.g. [X [GEN-Y]] < "X belongs to Y" in Tok Pisin)

Curr Anthr, +*Language*

So, if throwing Pāṇini's Cakra is not a safe route to exceptionless universals either, what next?

Justifying universals by first principles

- Criteria of Learnability (Chomsky 1964[*]ff): a universal is justified if we need it for explaining the fact that language is learnable.

  But: phonotactics, word structures, postpositions, non-nested NPs etc. are all learnable from the input even without assuming syllables, words, FOFC, obligatorily nested NPs!

- Perhaps, unlike this kind of stuff, we need at least hierarchical phrase structure, with labels and dependencies (MERGE), for learnability

  But: even CFG grammers (with strong generative capacity and structure dependence), turn out to be learnable from the input (Ambridge et al. 2008[+], Perfors et al. 2011[#])!

[*]*Aspects*, [+]*Cogn Science*, [#]*Cognition*

Justifying universals by first principles

- Considerations of Evolution (Chomsky 2004*ff): a universal is justified if we need it for explaining the fact that language evolved

  But: no evidence that syllables, words, FOFC, obligatorily nested NPs are needed, and such things would have unclear selectional advantages anyway

- Perhaps, unlike this stuff, we need at least MERGE for explaining language evolution because this directly captures the supra-regular capacity that humans have, unlike other species (cf. Fitch's talk)

  But: MERGE is only one of many ways of computing supra-regular syntax; e.g. model-theoretic syntax (Pullum & Scholz 2001+), Construction Grammar etc. → no help for arbitrating universals

*in *Structures and Beyond*, in +*Logical Aspects of Computational Linguistics*

So, if not even considerations of “explanatory adequacy” are a safe route to exceptionless universals either, what now?

Two options

A. Keep on throwing Pāṇini's Cakra anyway: keep universals as "working hypotheses", or "programs", and fight for them at all costs!

B. Give up on universals!

An alternative: a normal science, post-Pāṇinian approach

- **How do specific parts of languages arise and develop over time (evolutionary, historical, or over the lifespan), given their natural and social ecology?**

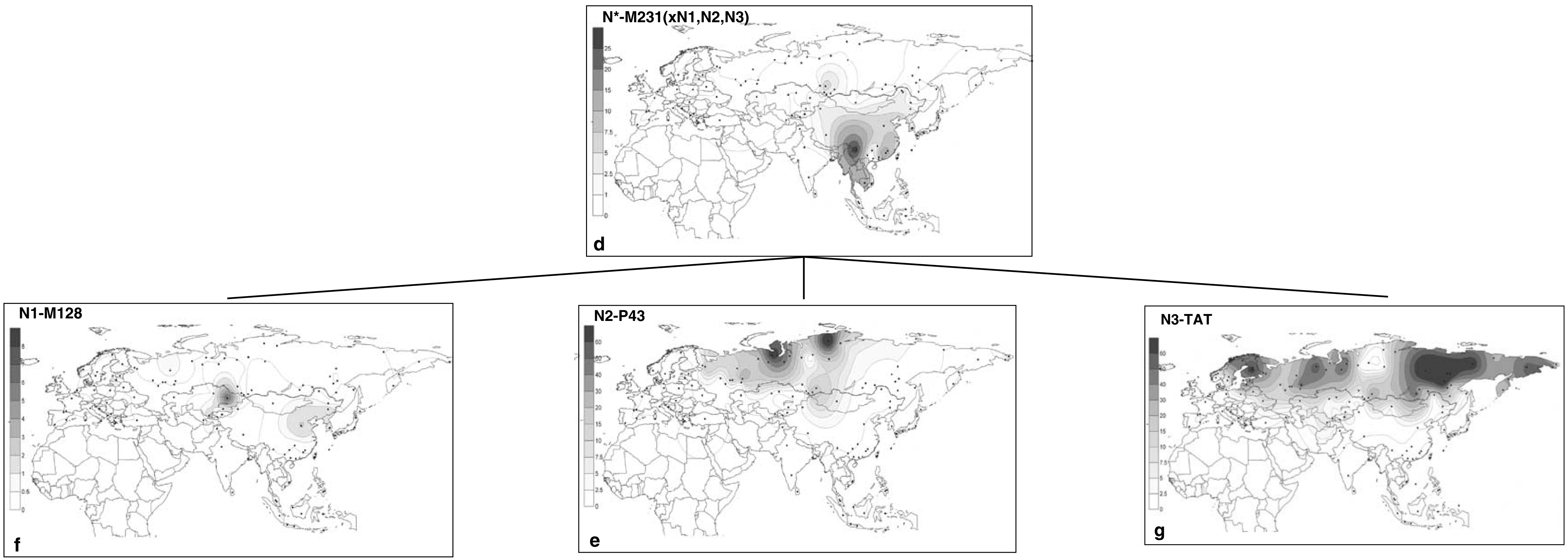
- For this, we need:

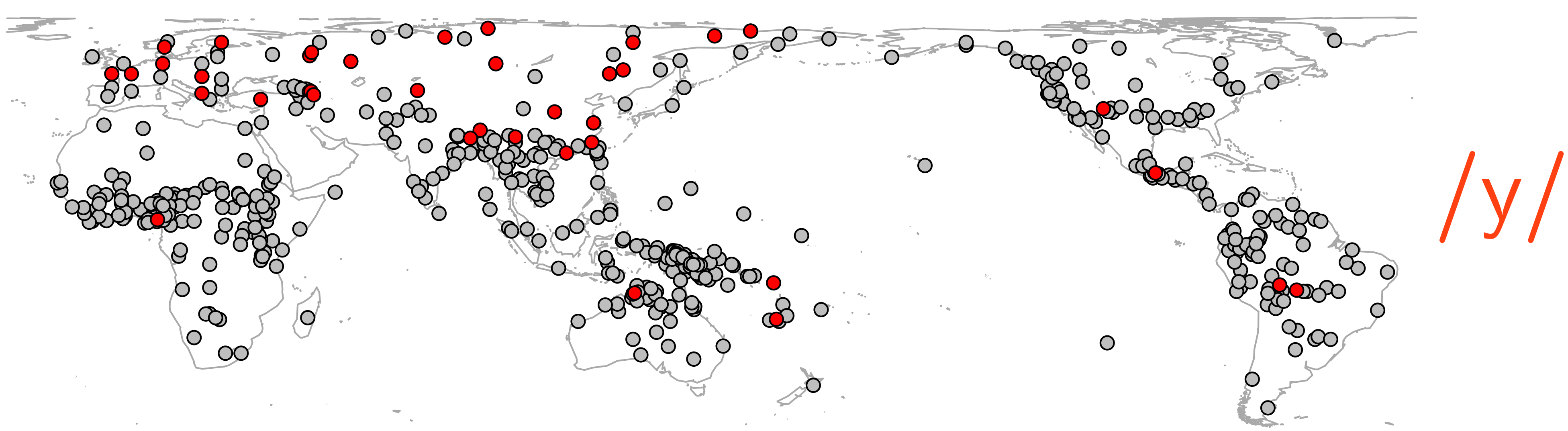
  1. Causal theories on how natural and social factors drive language evolution, change and development so that structures end up with the distributions we observe

  2. Fine-grained variables for measuring these distributions, formulated in sync with what we know about processing, acquisition etc

  3. Statistical models for testing (1) against (2)

- **Event-based theories:** once-off spreads, limited to concrete historical events, e.g. in Eurasia, over a period of at least the past 14ky





Rootsi et al. 2007 in *Europ J Hum Gen*, Maddieson 2005 in *WALS*

Causal theories — some examples

- **Functional theories:** cognitive/physiological and social/communicative principles cause certain directions in language evolution and change so that languages better fit their environment, e.g.
  - High cost of voicing in word-final position favors development and maintenance of final devoicing (Blevins 2004*)
  - Communicative need for distinguishing questions from statements causes development and maintenance of interrogative vs. declarative form (Dryer 2005+)
  - *Perhaps*: certain kinship systems favor development and maintenance of special "kintax" morphology (Evans 2003 for review#)
  - *Perhaps*: supra-regular computation in pattern recognition favors the development and maintenance of embedded phrase structures (cf. Fitch's Dendrophilia Hypothesis)

**Evolutionary Phonology, +WALS, #Ann Rev Anth*

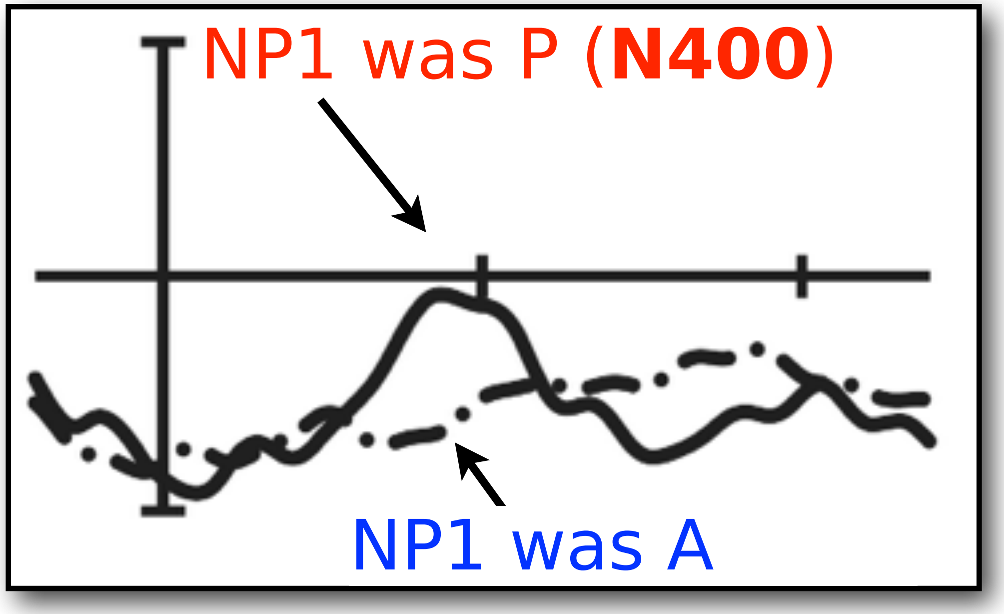
Case study: a causal theory

- Joint work with Ina Bornessel-Schlesewsky demonstrates cognitive primacy of A arguments:

dass	*Peter*	*Lehrerinnen*	***mögen*** **[NP1 was P!]**
that	Peter: ~~S~~/A/P?	teachers: A/P?	**like**
			mag **[NP1 was A!]**
			likes

- The comprehension system tends to first assume that an unmarked initial NP is S or A, but not P
- If this NP later turns out to be P, this costs something:

  → ERP effect ("Anti-Ergative Effect")

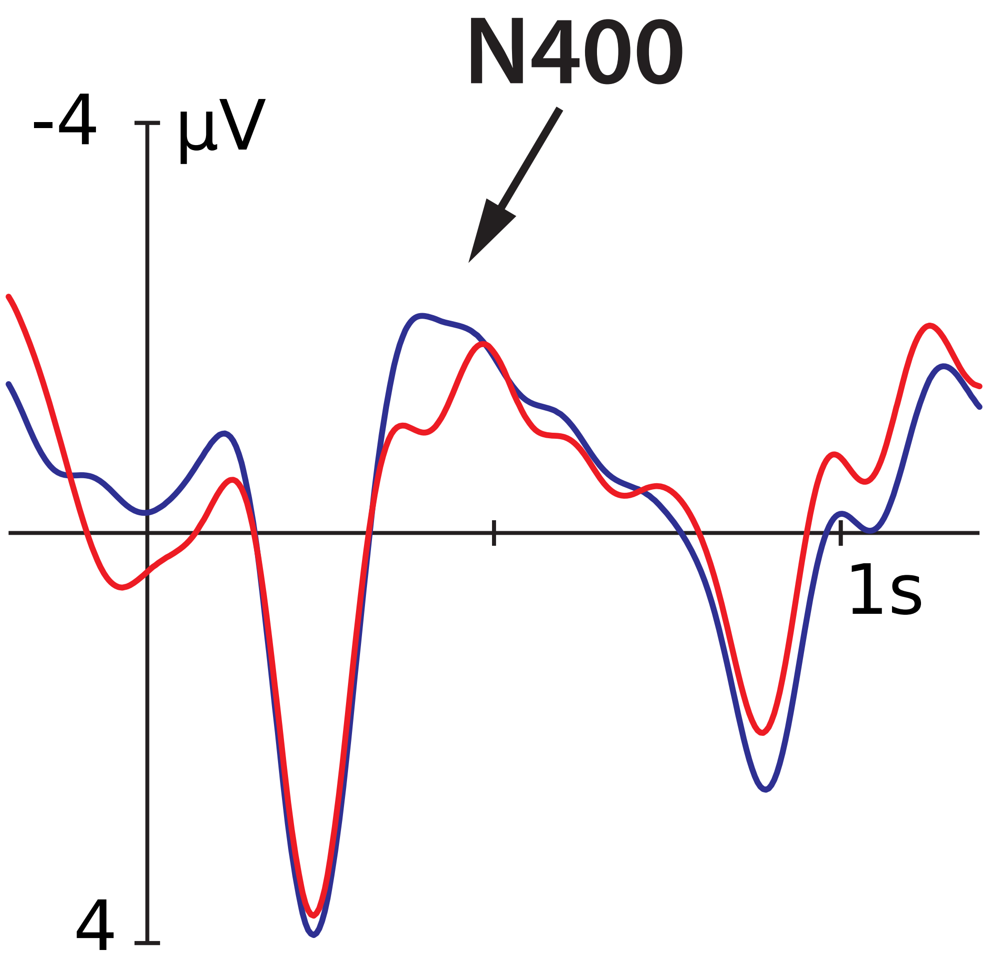


The Anti-Ergative Effect is independent of

- *Frequency:* because of frequent A drop, initial NPs in Turkish tend to be P arguments, but the effect is still there (Demiral et al. 2008*)
- *Animacy:* initial NPs in Turkish tend to be inanimate, but the effect is still there (Demiral et al. 2008*)
- *Topicality:* initial NPs in Chinese show the effect regardless of whether the context makes them topical or not (Wang et al. 2010+)
- *The role played by {S,A} vs {P} alignment in grammar:* very restricted relevance in Chinese but the effect is there nevertheless (Wang et al. 2009#)

And it even shows up in languages with ergative case, such as Hindi:

kitāb	*bec-ī*	*(Rām-ne)*
book(FEM)[NOM]	sell-PP.FEM	Ram-ERG
kitāb-ko	*bec-ā*	*(Rām)*
book(FEM)-ACC	sell-PP.MASC	R[NOM]



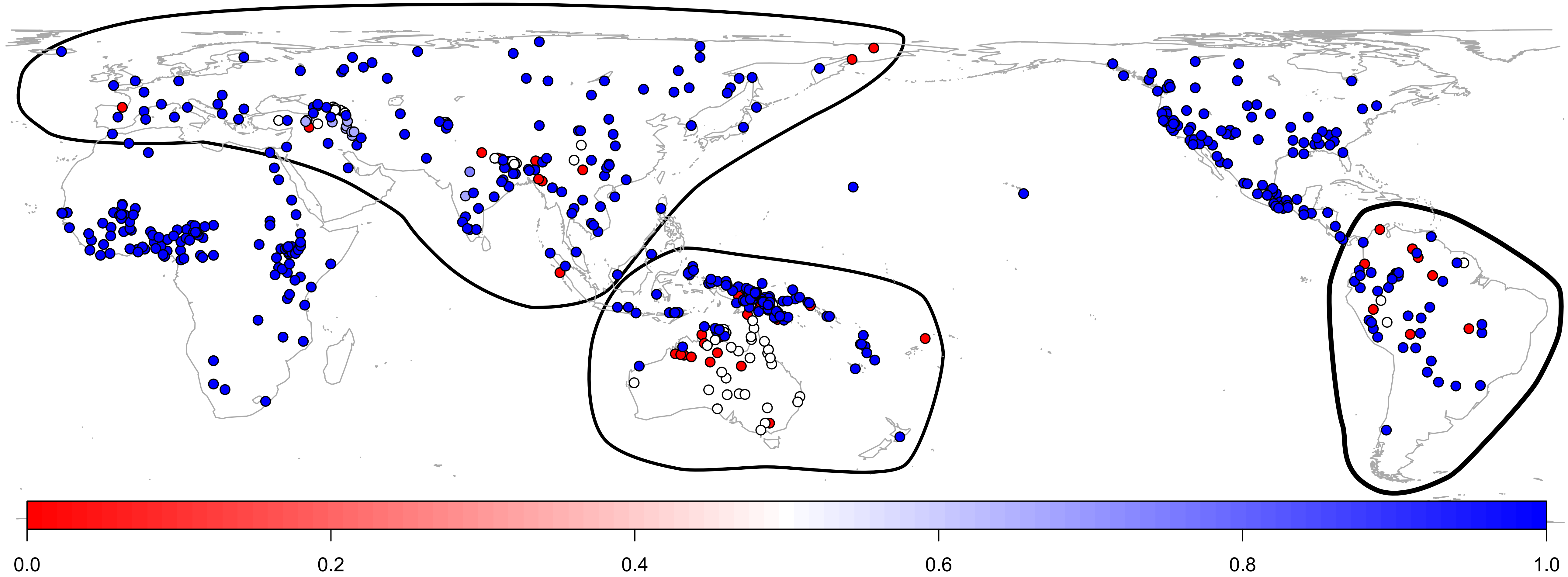
Although Hindi NOM structurally includes and often prefers a P-reading, the processor first interprets it as S or A!

Hypothesis

- If the Anti-Ergative Effect indeed applies universally to every unmarked initial NP, and if systems adapt to their processing environment, expect them
  - to attempt to reanalyze initial NPs as covering {S,A}
  - to avoid reanalyzing initial NPs as covering {S,P}
- But expect actual signals in diachrony to be weak:
  - the costs are low and so ergative systems can be happily processed and transmitted over generations
  - actualization requires many opportunities for change (many speakers, many generations)
  - there are many counter-acting forces, e.g. conservatism, areal spread, new developments of ergatives, e.g. from focus markers highlighting the special saliency of agents, spread of special valency classes etc.

Testing the hypothesis

- Tested on 617 languages, 712 subsystems (e.g. past vs. nonpast); excluding V-initial structures
- Controlling for possible event-based areal diffusion effects



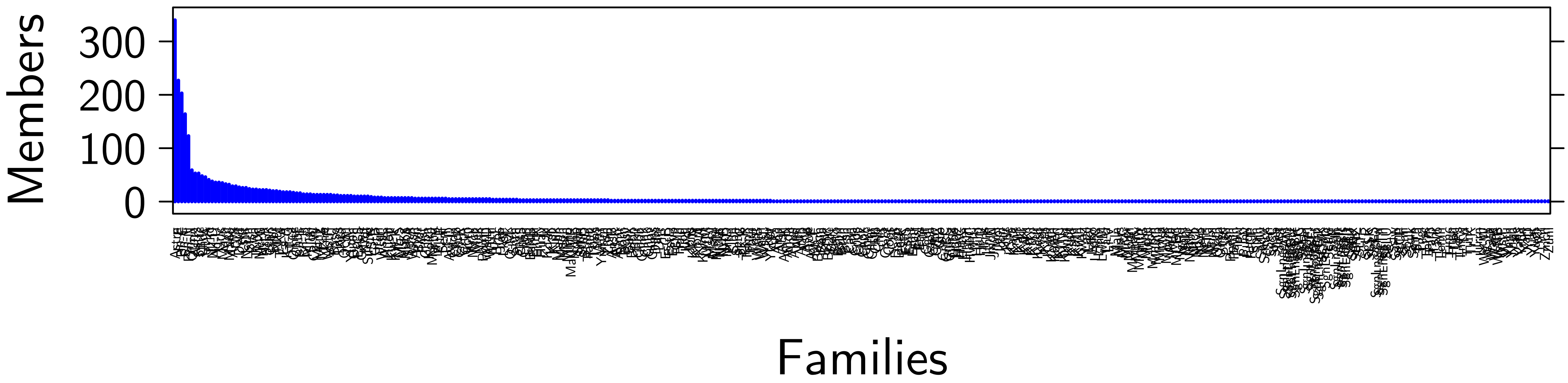
E (S≠A) A (S=A)

(means per language, across all NP types, clause types, and valency classes)

How to estimate trends in diachrony worldwide?

Need a method that

- captures effects over time, not simply synchronic distribution (because there is no guarantee of stationarity, Maslova 2000*)
- yet also picks up signals from isolates and small families



- and picks up signals from innovating as much as from maintaining a preferred structure
- and allows assessing confouding effects such as those from areal diffusion, other processing factors — and interactions between all these

*Ling Typ

The Family Bias Method

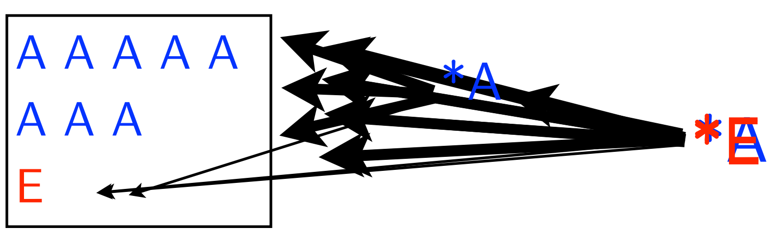
- **Step 1: estimate biases in diachrony in large families (N>5).**

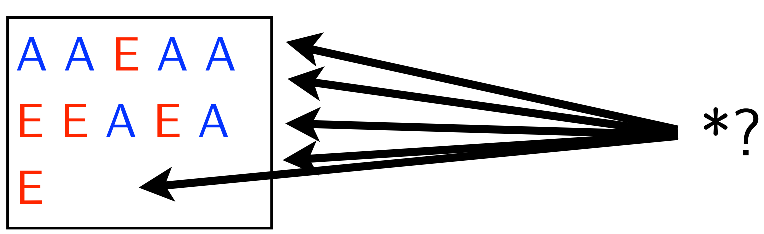
  Several options, *two of which are used here:*

  A. Set-based methods (ignoring tree topologies)

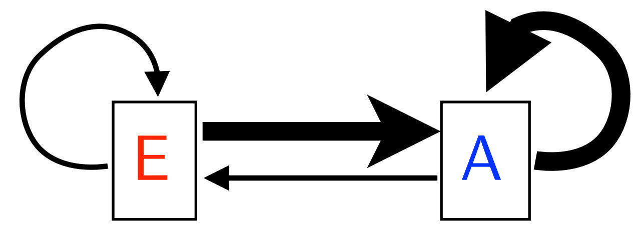
Observations in *demonstrably related* languages:

Possible diachronic interpretations:





Inference (under all interpretations):



$P(E{>}A) > P(A{>}E)$

("Family Bias")

$P(E{>}A) \approx P(E{>}A)$

("no bias", "diverse", "neutral")

→ Conclude bias if there are more A than E, as decided by a binomial test

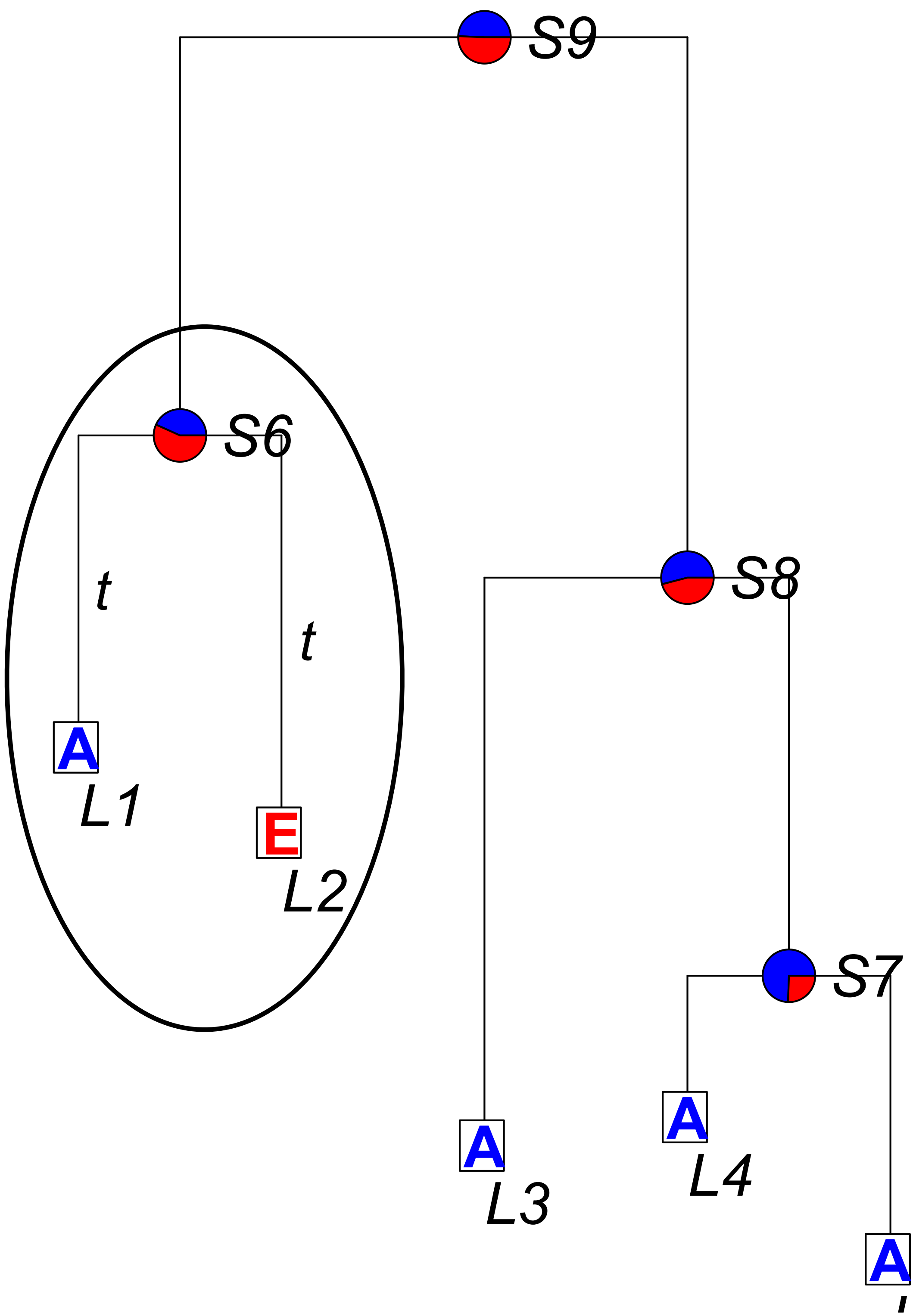
Bickel 2011 in *Ling Typ*, 2013 in *Lang Typol and Hist Cont;* Software: `familybias` (`comparativelinguistics.uzh.c`

- **Step 1: estimate biases in diachrony in large families (N>5).**

Several options, *two of which are used here:*

B. Tree-based methods
(as used e.g. by Dunn et al. 2011*)

- Estimate the transition rate matrix of a continuous-time Markov model so that it maximizes the likelihood, e.g.
$$L(D|T) = \sum_{i \in \{A,E\}} P_{S_6}(i) P_{iA}(t) P_{iE}(t)$$
- Or, approximate Bayesian marginal likelihoods via MCMC sampling over trees
- Compare these likelihoods to infer biases, *P*(E>A) > *P*(A>E)
(Pagel 1999+, 2004+; Felsenstein 2004#)



*Nature, +Syst Biol, #Inferring Phylogenies; Software: `BayesTraits` and `R:geiger`

The Family Bias Method

- Set-based vs. tree-based estimates have both advantages and disadvantages:

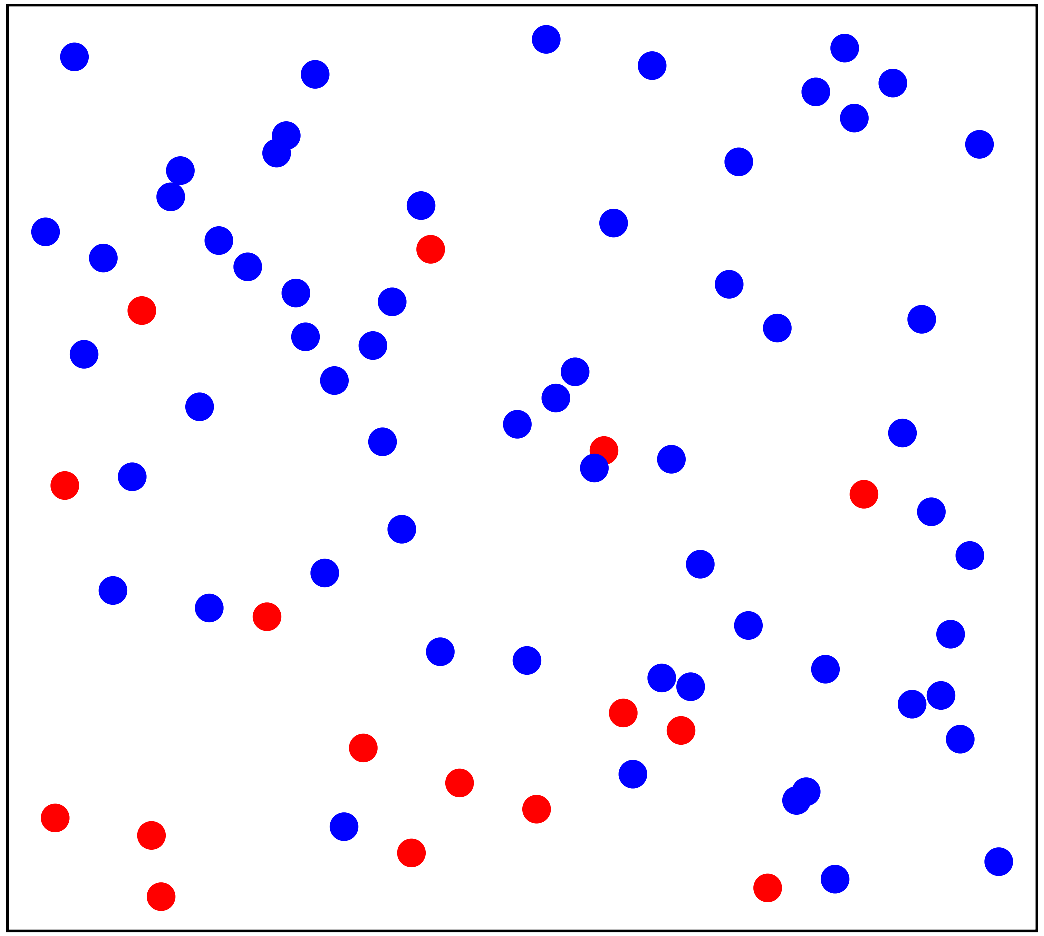
	set-based	tree-based
need branch lengths (known or	**no**	**yes**
need tree topology (known or	**no**	**yes**
can handle invariant data	**yes**	**no**

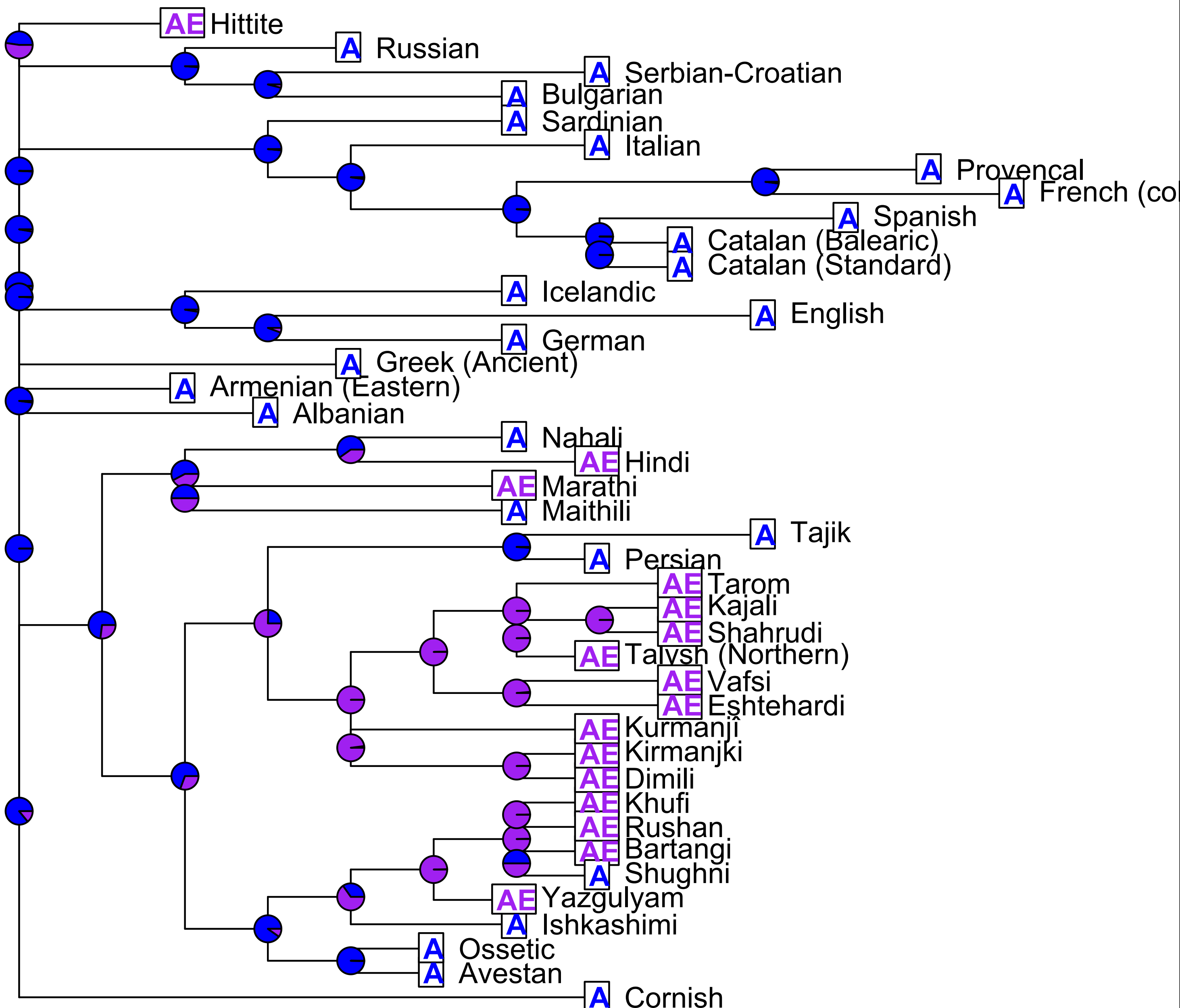
- Use both when possible and compare results.
- Same results in our dataset, except for Indo-European...

The Family Bias Method: Indo-European

Set-based: $P(E>A) > P(A>E)$, $p<.001$

Tree-based, $P(E>A) \approx P(A>E)$
ML logBF=.08 (p=.77)

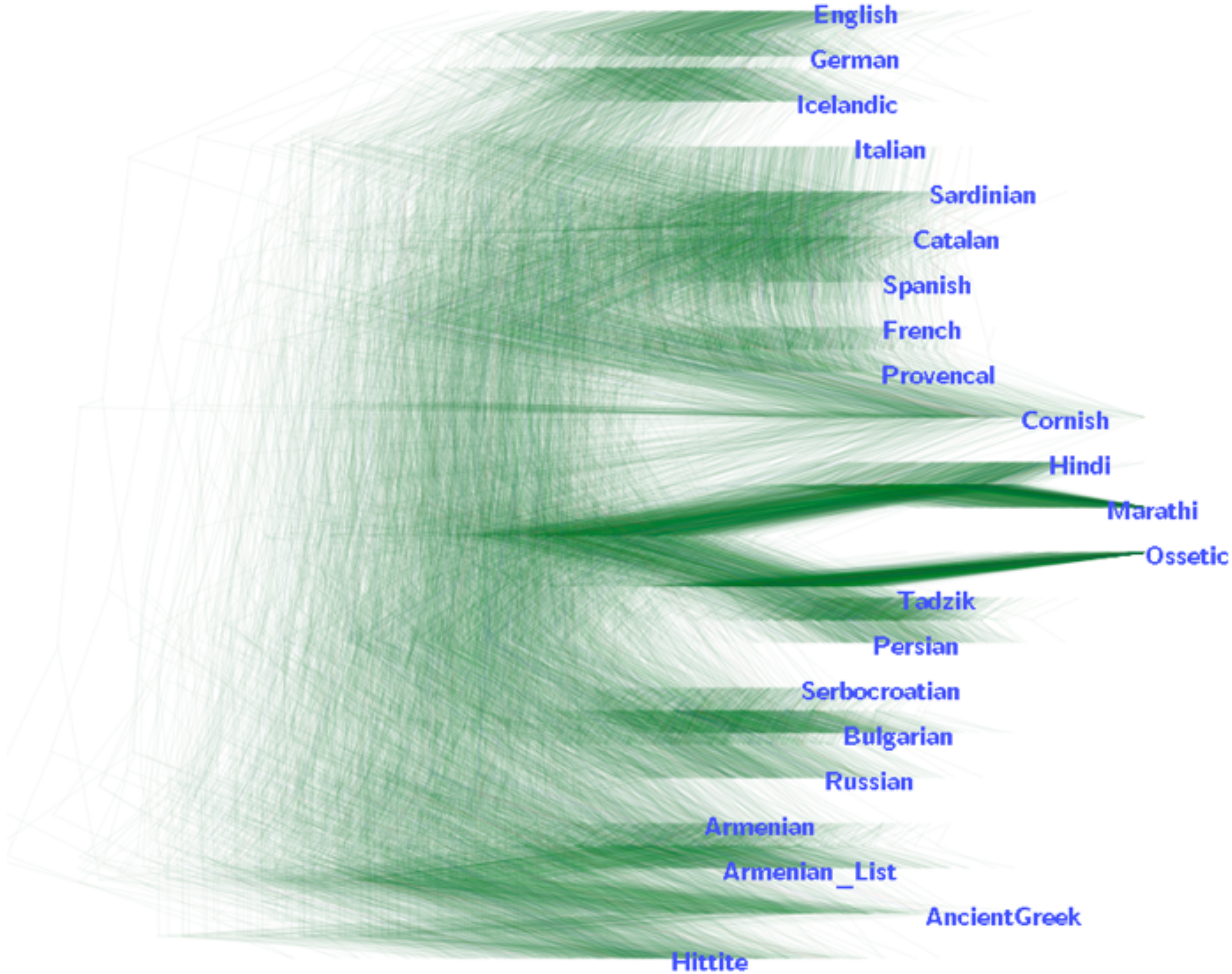




(Topology and branch lengths based on nodes in Glottolog)

The Family Bias Method: Indo-European

- But no difference when based on estimated instead of fixed tree (BayesPhylogenies based on cognate replacements; Dunn et al. 2011*):



$P(E>A) > P(A>E)$
MCMC logBF=6.49

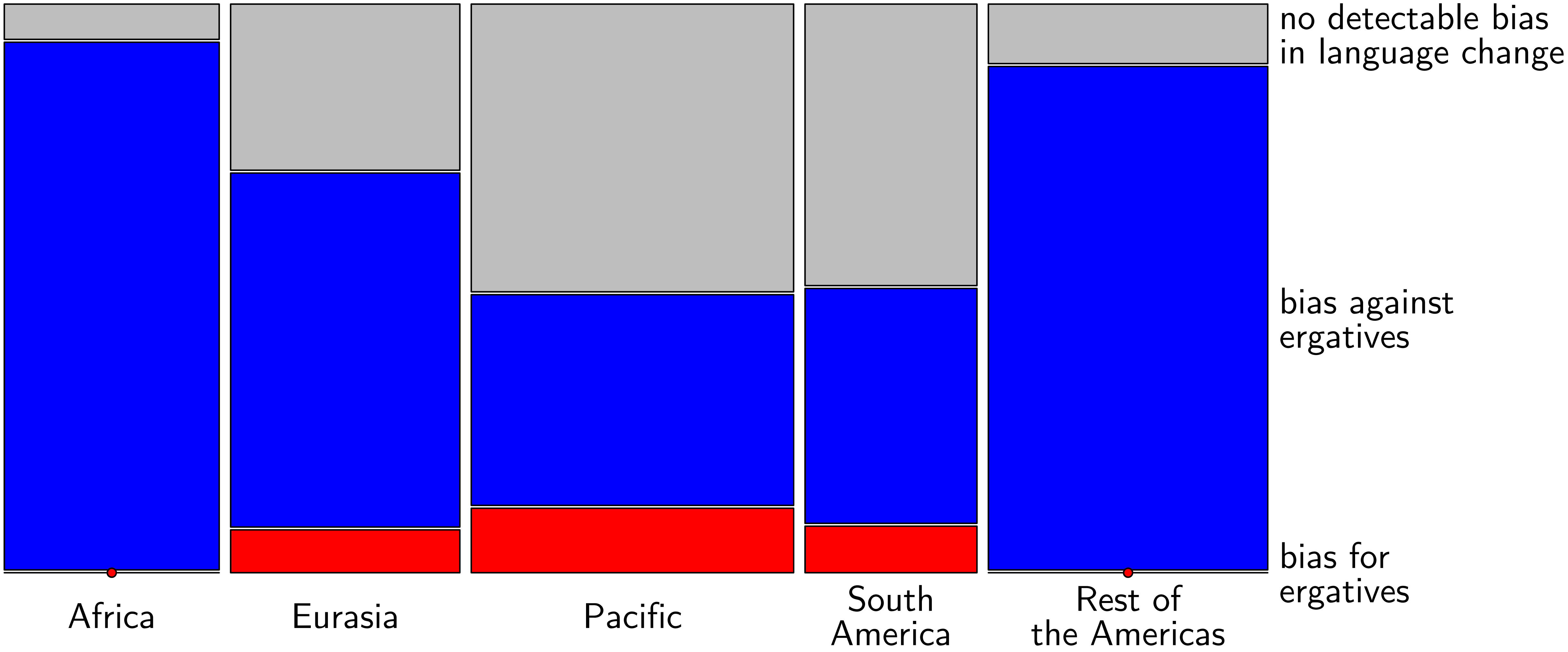
*_Nature_, Thanks to Michael Dunn for sharing the trees

- **Step 2: estimate bias probabilities behind small families and isolates**
  - Use the mean probability of bias in large families for estimating the probability that a small family is what survives of a large family with a bias (in whatever direction: S=A or S≠A)
  - if estimated to be biased, estimate direction of bias value (e.g. S=A) based on what they have, allowing for deviations with a probability based on deviations in large families, and resolving ties at random
  - take the mean across many extrapolations (e.g. 2,000)

Simulation study shows that this method is very conservative:

- overestimation of biases and bias direction $\leq$ .05
- underestimation $\leq$ .21 for biases, $\leq$.07 for bias directions

The Anti-Ergative Effect in diachrony: results

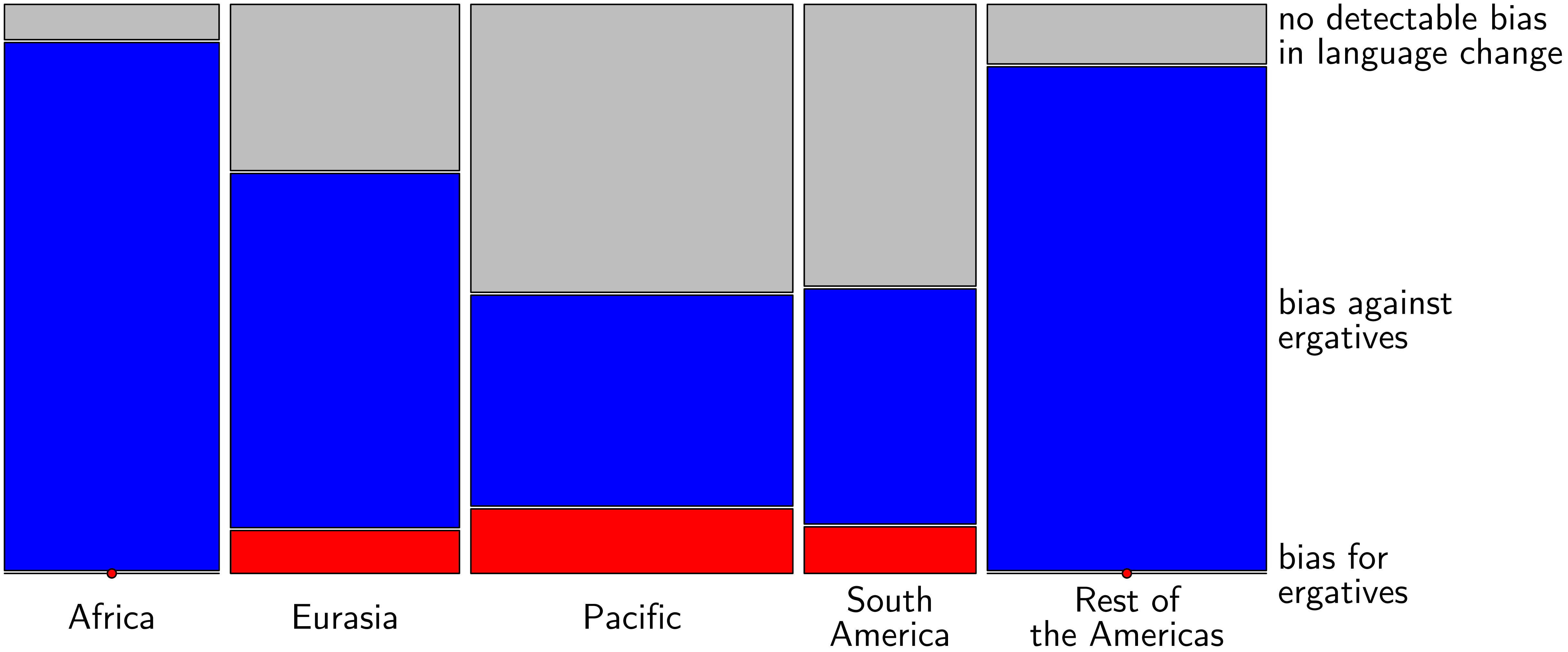


Bias for ergatives vs. against ergatives is determined both

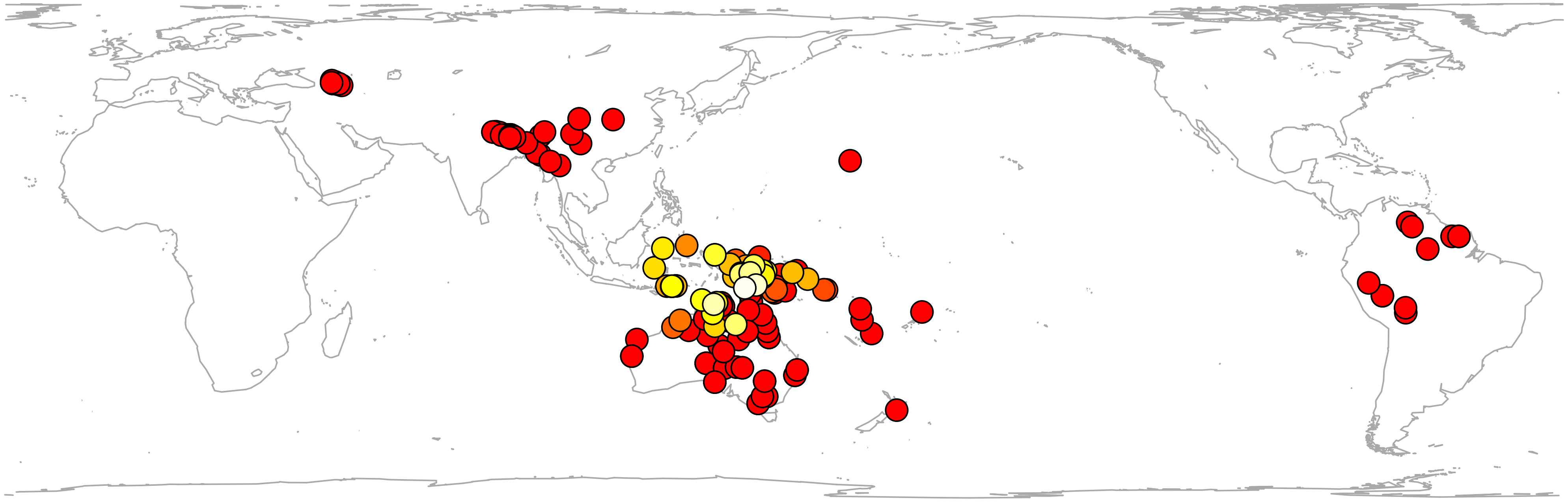
- by contact histories (AREA × BIAS DIRECTION, p=.003)
- by Anti-Ergative Effect: proportion of ergative biases smaller than proportion of anti-ergative biases across all areas (all ps<.05)

Results are independent of method for large family estimates (set-based, tree-based, ML, MCMC, AUTOTYP vs. GLOTTOLOG trees etc.)

The Anti-Ergative Effect in diachrony: results



Diversification strongly depends on area ($p < .001$)



Conclusions

- Results do not depend on
  - individual datapoints ("counterexamples") and fights on what is the "right" analysis (throwing *Pāṇini's Cakra*), but on general, quantifiable patterns
  - sampling choices, since with methods like the Family Bias Method we can use exhaustive samples (unlike in classical, sampling-based typology)
- Approach in line with the normal science triad — causal theory, data, statistical modeling
- and in line with the old insight that **nothing in linguistics makes sense expect in the light of history** (cf. Dobzhansky re biology)

`http://www.spw.uzh.ch/distributionaltypology`

Thanks to my colleagues in the Anti-Ergative study

- Ina Bornkessel-Schlesewsky (Marburg)
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