Latent Geographical Factors for Analyzing the Evolution of Dialects in Contact

MURAWAKI Yūgo
Kyoto University

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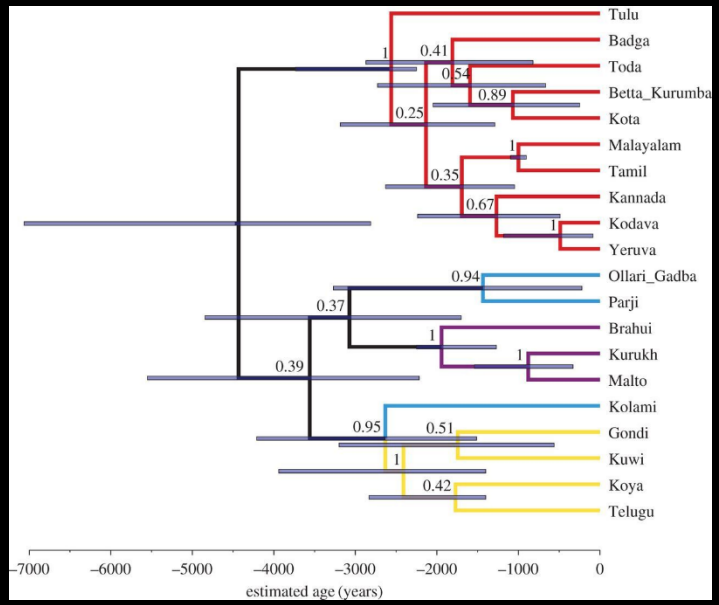
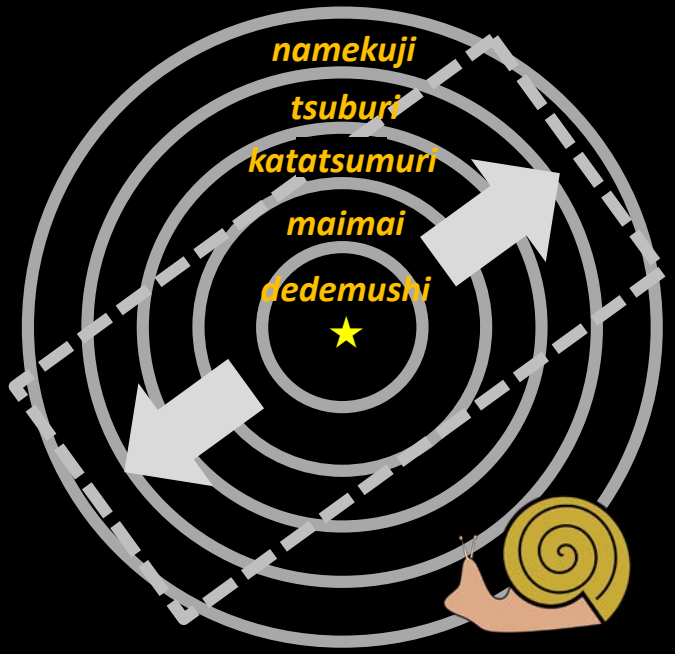
Background: Two modes of evolution

Vertical inheritance (tree-like)



[Kolipakam+, 2018]

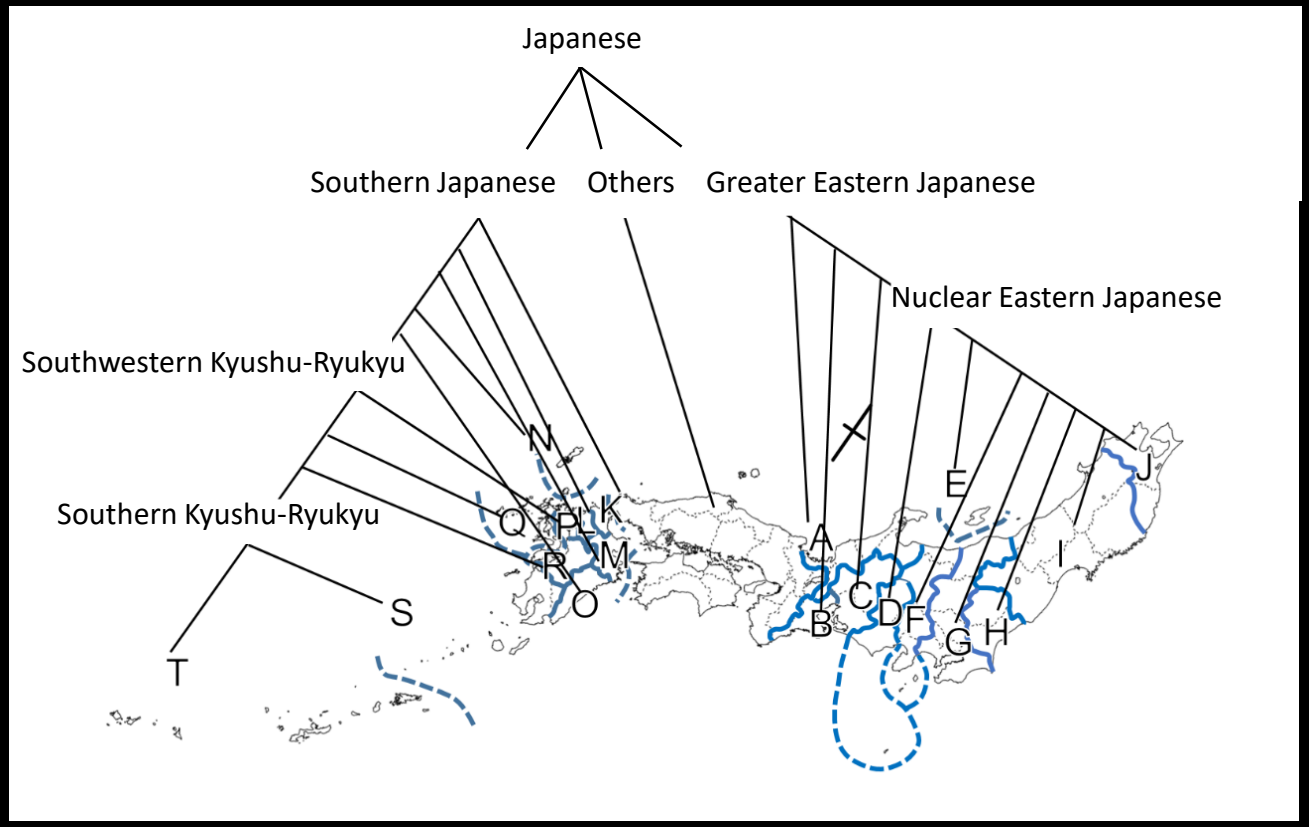
Horizontal transfer (wave-like)



[Yanagita, 1930]

The evolution of dialects in intense contact has mostly been explained in terms of horizontal transfer

Recent studies suggest even dialects show traces of vertical inheritance

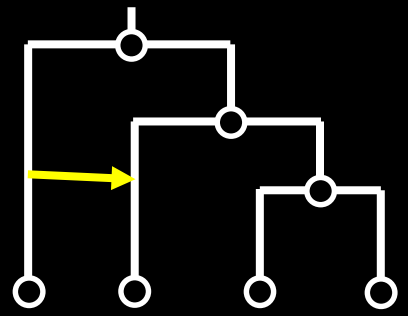


Adopted from [Igarashi, 2018]

Limitations of manual inference and statistical modeling as a solution

- Linguists base their inference on high certainty traits (*shared innovation*)
- But difficulties are inherent in telling signals of vertical inheritance from those of horizontal transfer
- Computer-intensive statistical models are better at handling uncertainty
  - The probabilistic tree model originating from evolutionary biology has been successful

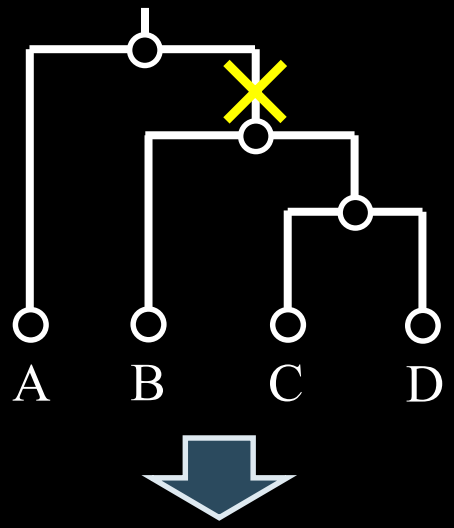
How can we jointly model the two modes of evolution?



- Incorporating horizontal transfer into the tree is impractical
- Some stick with the *vanilla* tree by showing its robustness wrt horizontal transfer to some degree [Greenhill+ 2009]
- Is it possible to develop a computationally feasible, approximate model of vertical inheritance and horizontal transfer?

Idea: Both modes result in geographical distributions

Vertical inheritance (tree-like)



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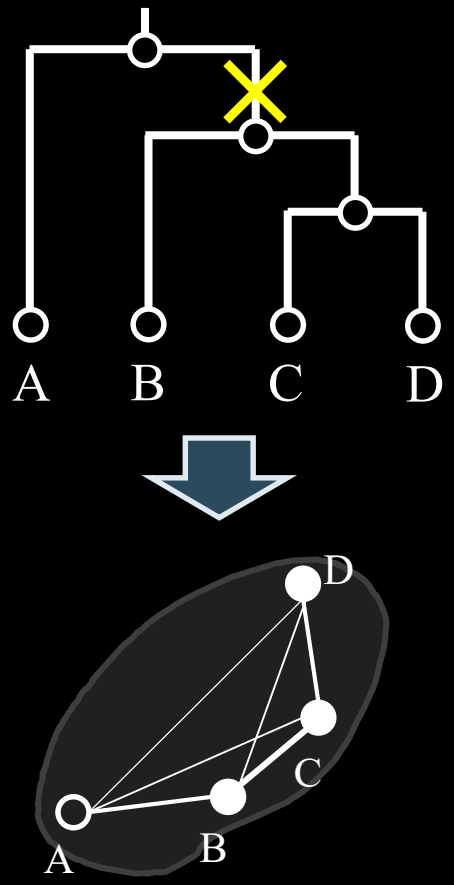
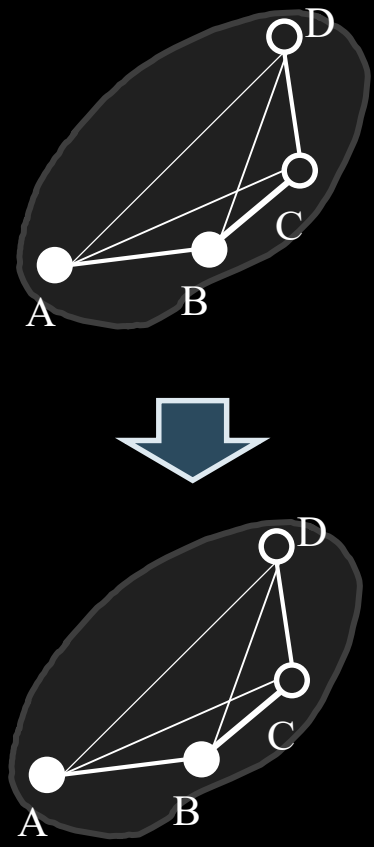
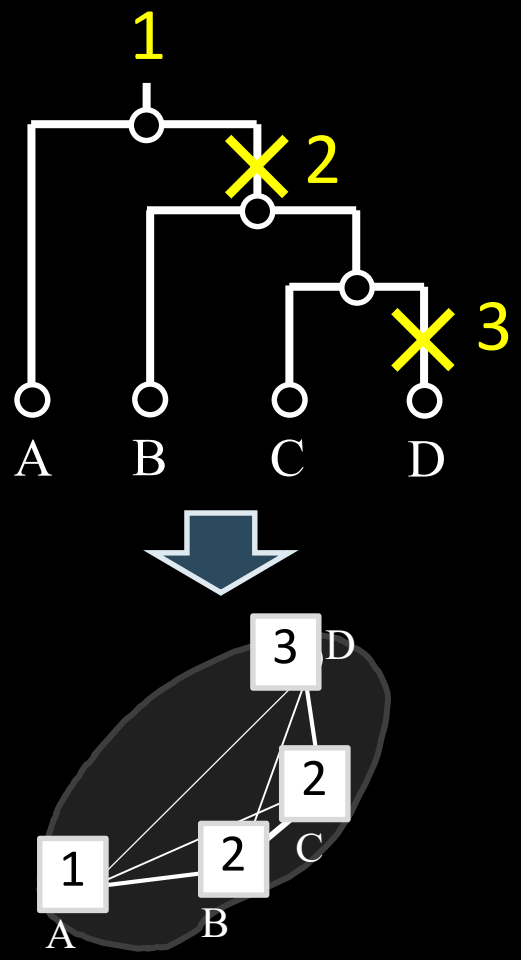


Horizontal transfer (wave-like)



Geographical distributions are not necessarily directly observable; hence *latent*



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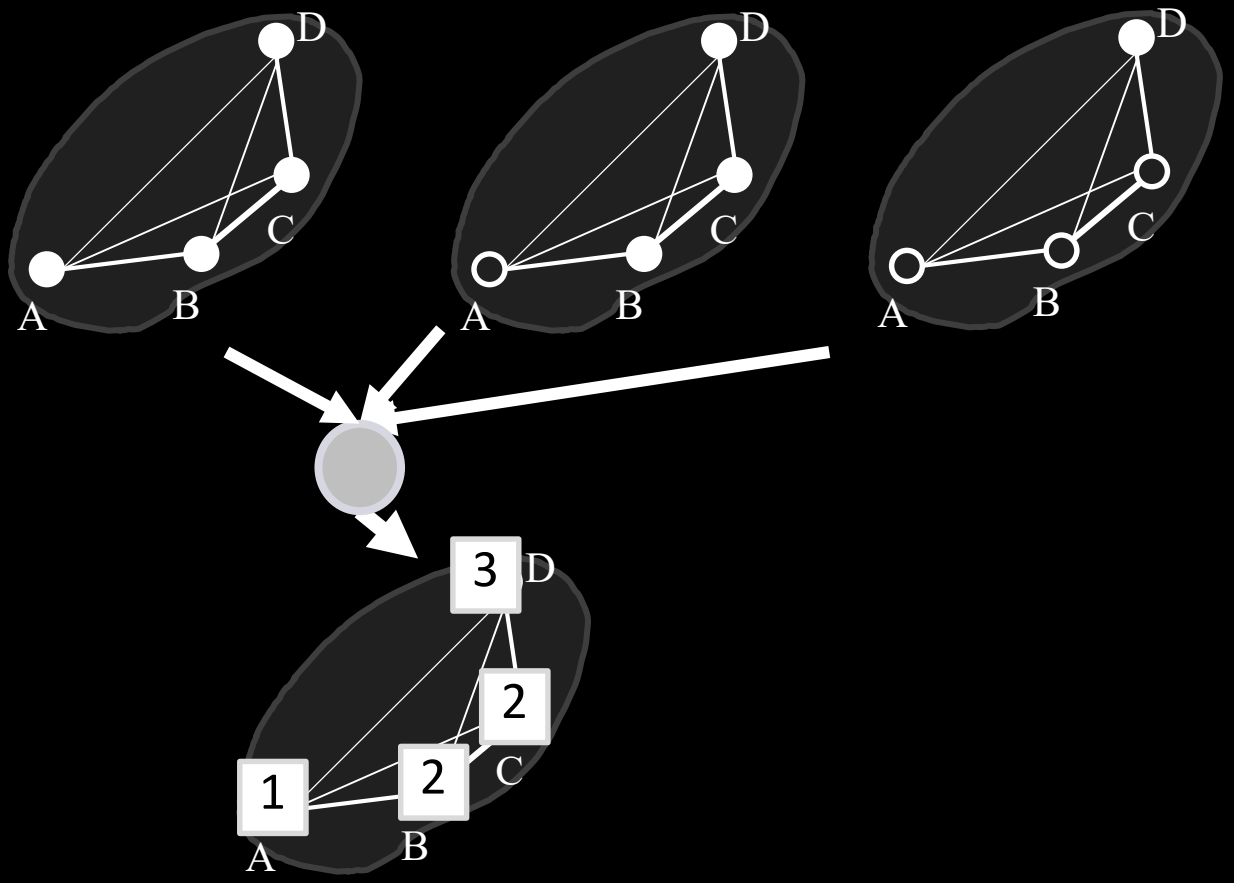
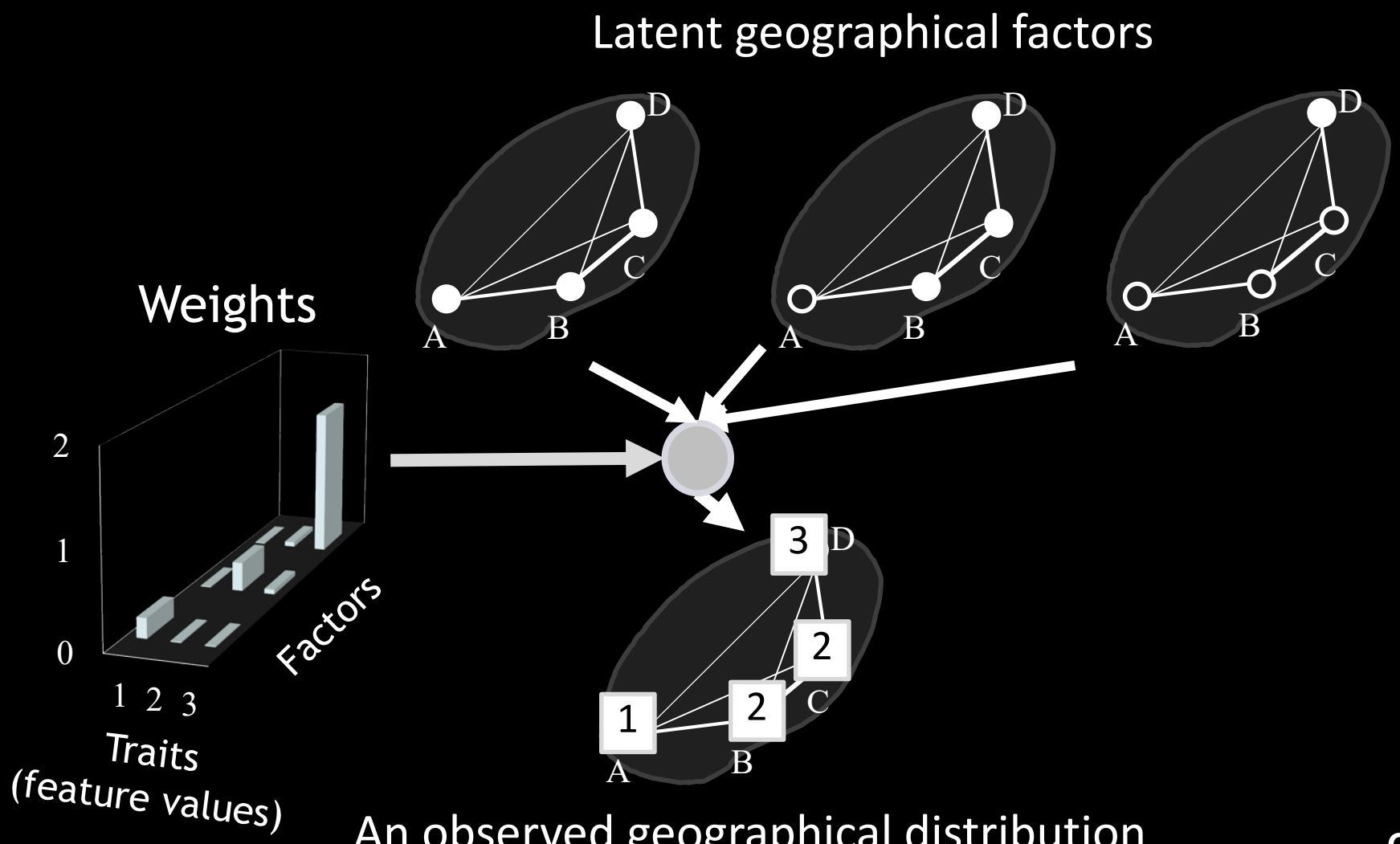
Latent geographical factors



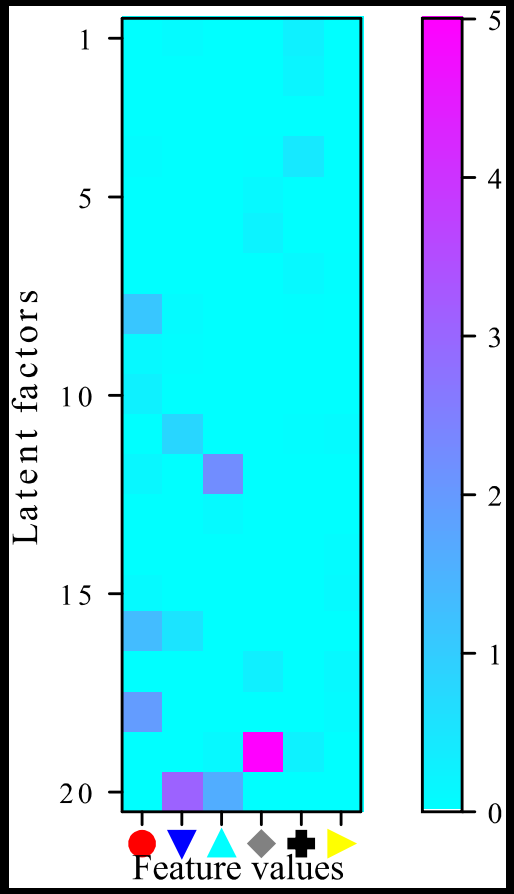
An observed geographical distribution

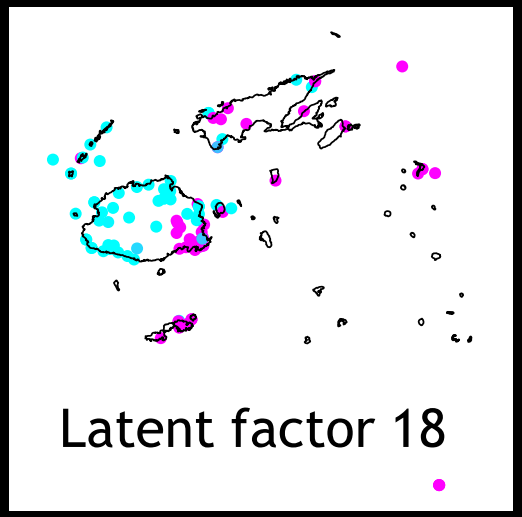
Latent and observed geographical distributions are stochastically connected with positive weights

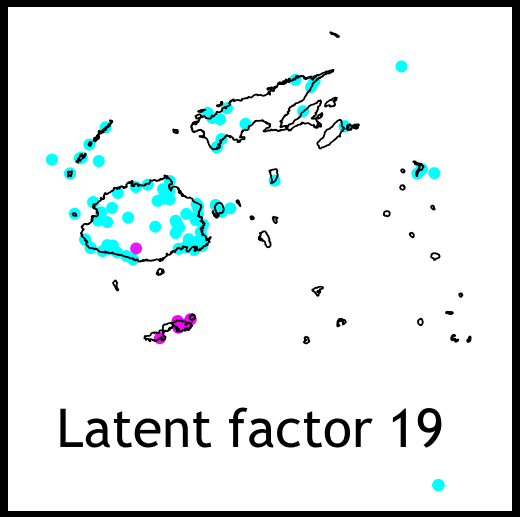


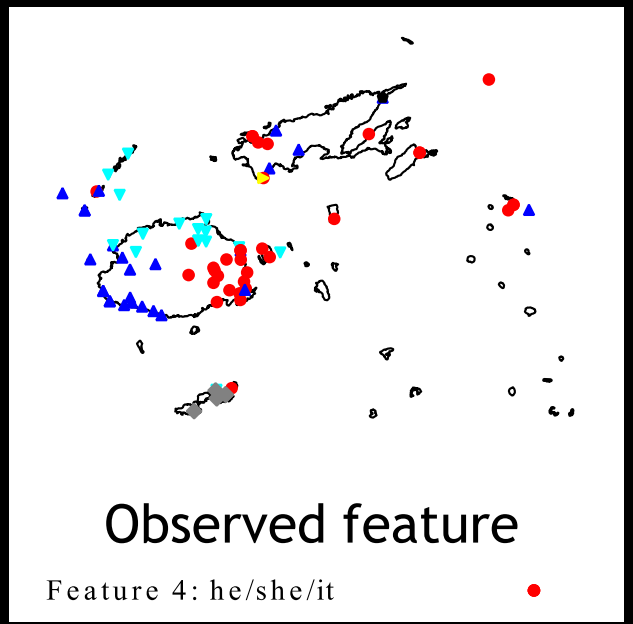
Experiments on Fijian lexical data

Weights









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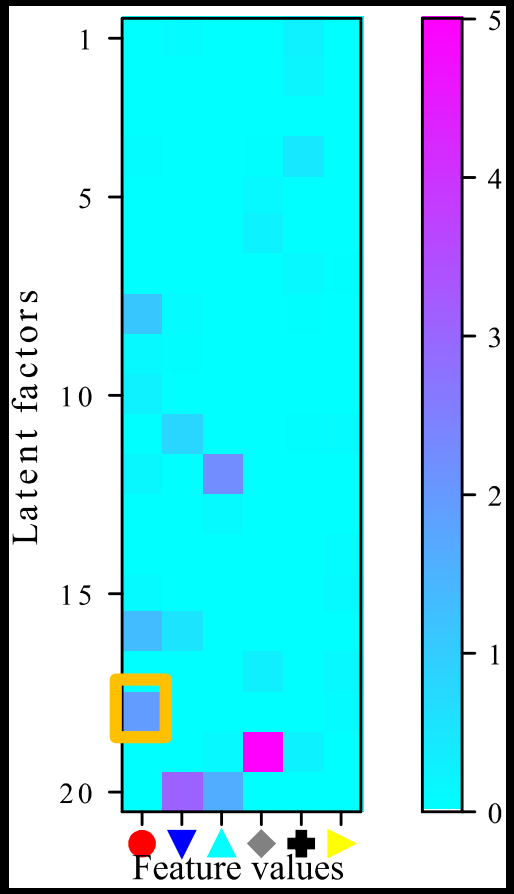

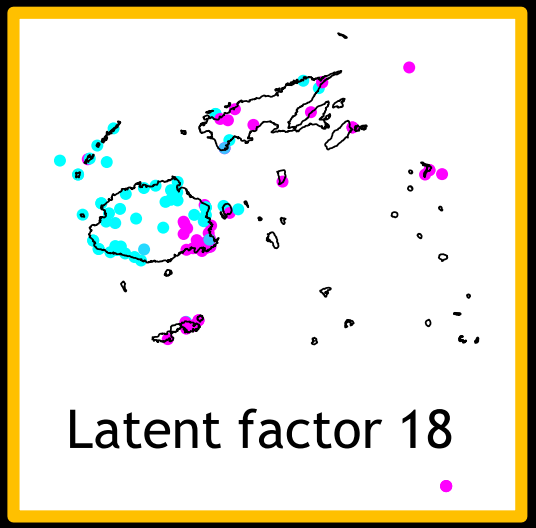

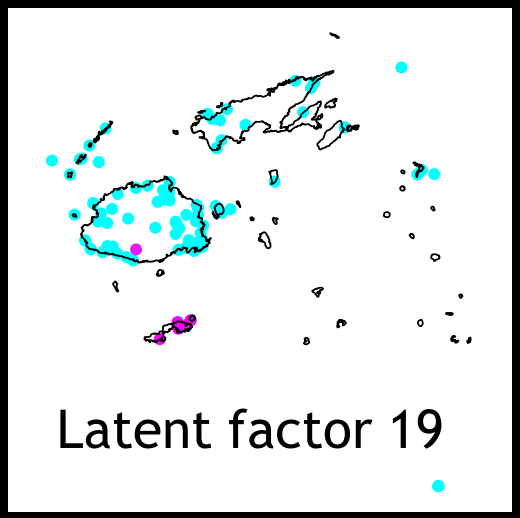

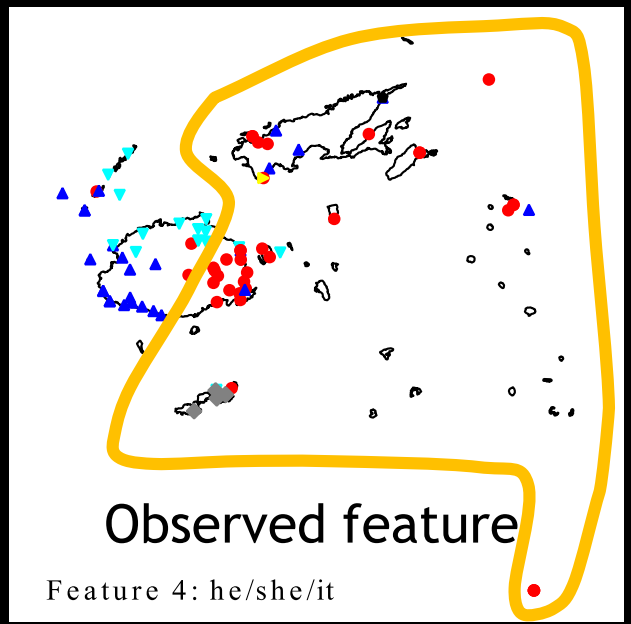

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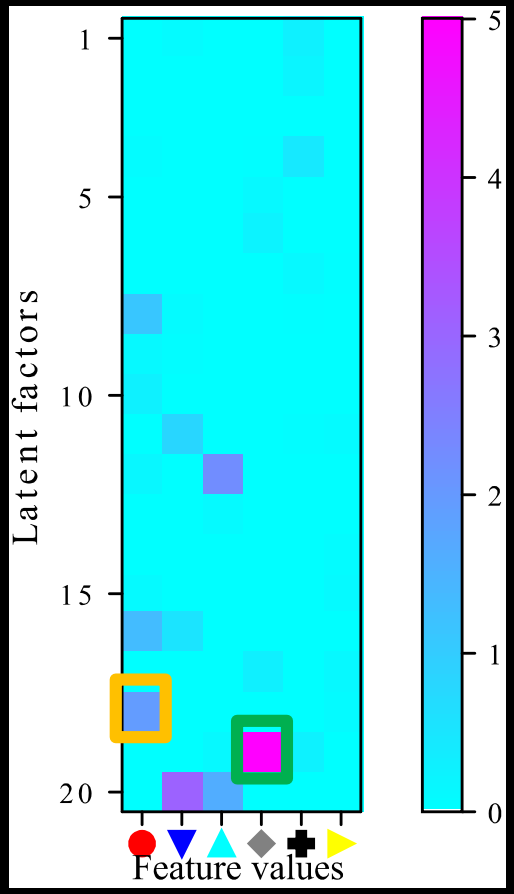

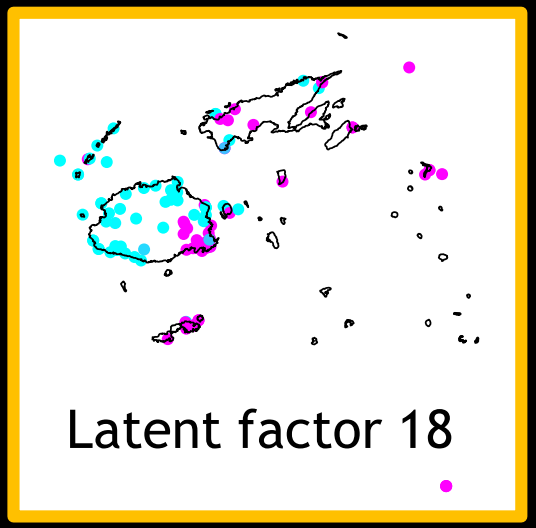

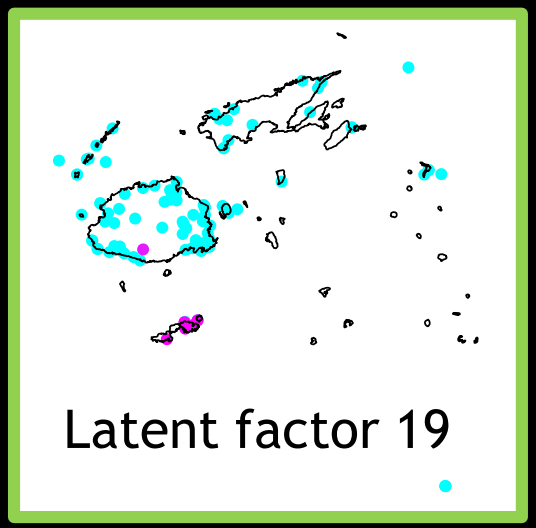

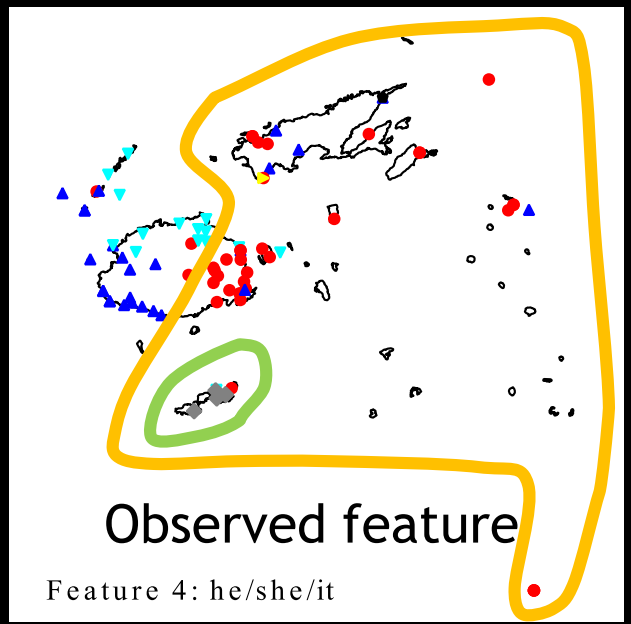

Conclusions and future work

- Proposed latent geographical factors as a means of modeling vertical inheritance and horizontal transfer in a unified way
- Experiments on synthetic and real data show promising results
- In the present model, latent factors are assumed to be independent
- To induce a tree, additional constraints should be imposed on vertical factors