Using Opinion Dynamics for Probing Cultural Spaces

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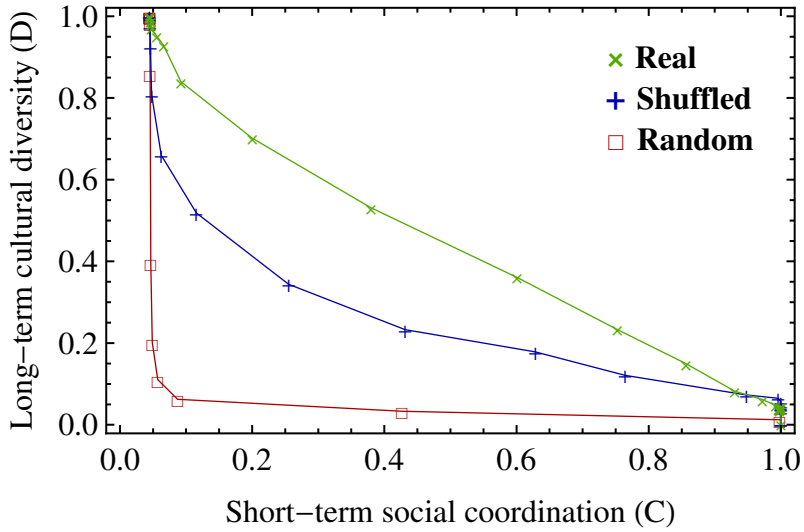
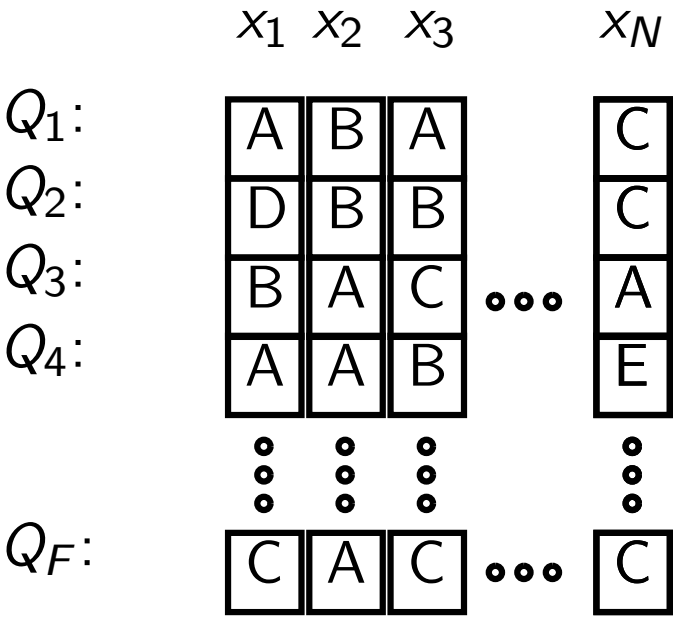
Background

- compatibility between:
  - long-term cultural diversity
  - short-term collective behaviour
- research questions:
  - robustness across data sets?
  - underlying mechanism?
- important concepts:
  - cultural space
  - $D(\omega)$ observable
  - $C(\omega)$ observable



Valori et al (2012), PNAS **109**: 1068-1073.

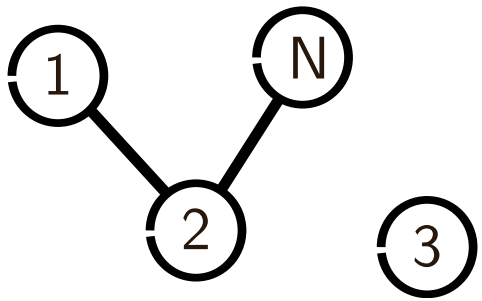
Cultural space



	x_1	x_2	x_3		x_N
x_1	0.0	d_{12}	d_{13}		d_{1N}
x_2	d_{21}	0.0	d_{23}		d_{2N}
x_3	d_{31}	d_{32}	0.0	•••	d_{3N}
			⋮		
x_N	d_{N1}	d_{N2}	d_{N3}		0.0

$$d_{ij} > \omega$$

$$d_{ij} = 1 - \frac{1}{F} \sum_{k=1}^{F} \delta(x_i^k, x_j^k)$$



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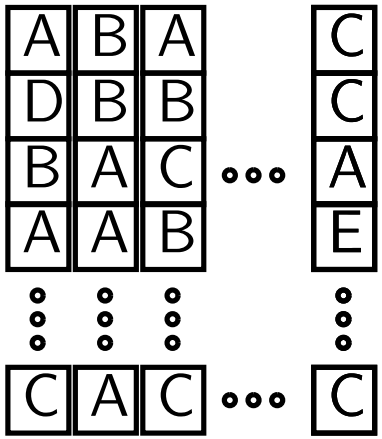
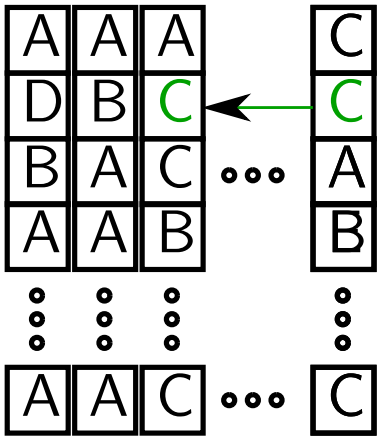
Long-term cultural diversity $D(\omega)$

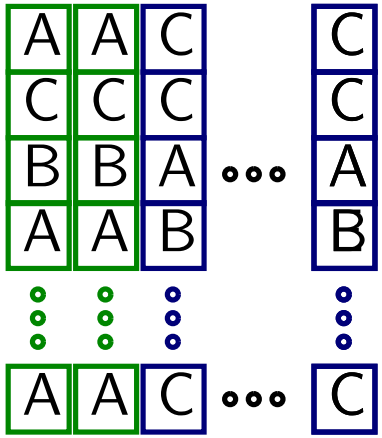
initial



intermediate

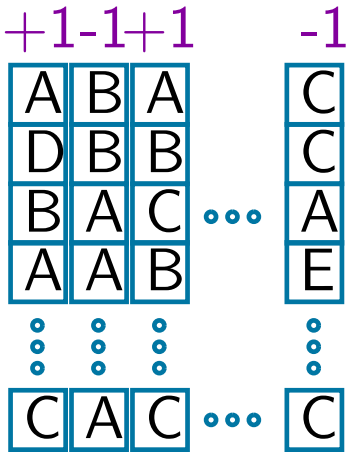


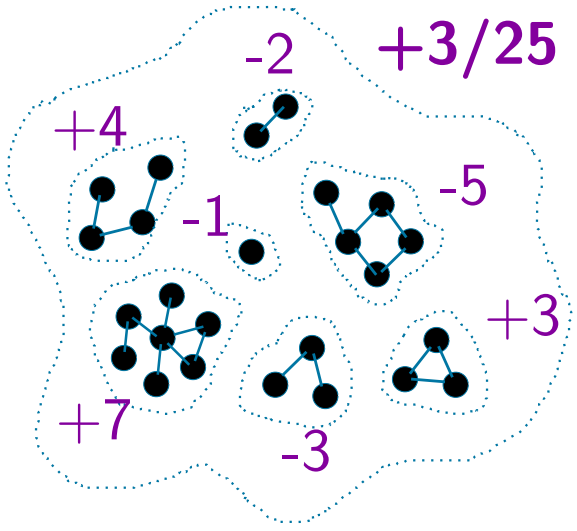
final (absorbing)

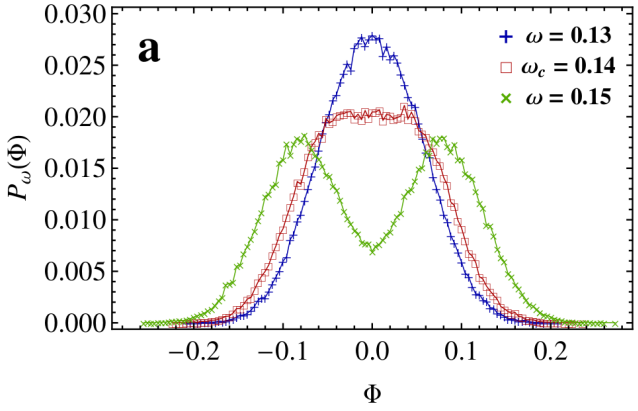


$$D(\omega) = \frac{\langle N_D \rangle_\omega}{N}$$

Short-term collective behaviour $C(\omega)$



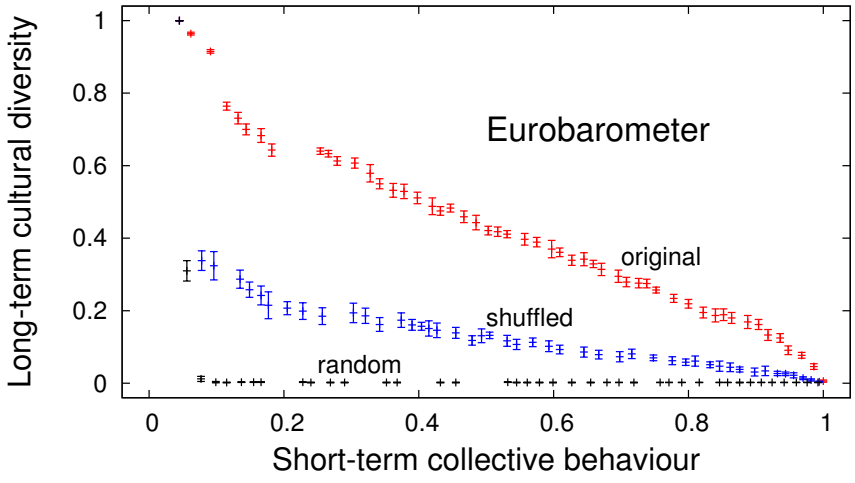


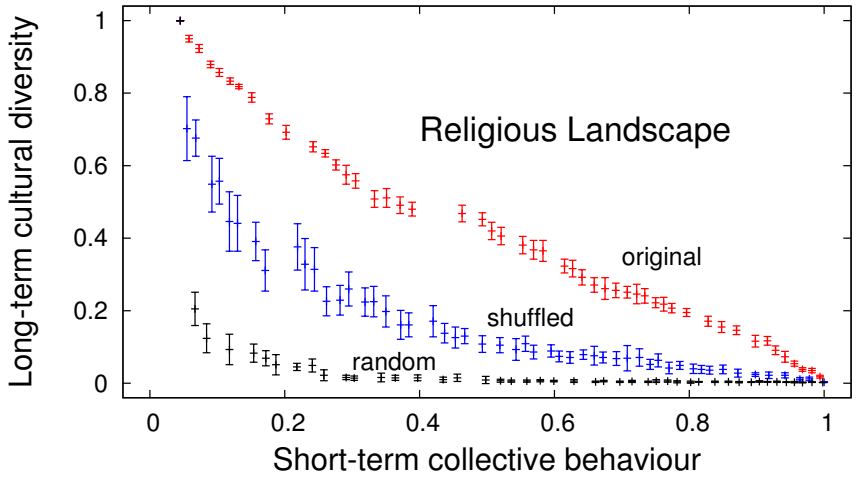


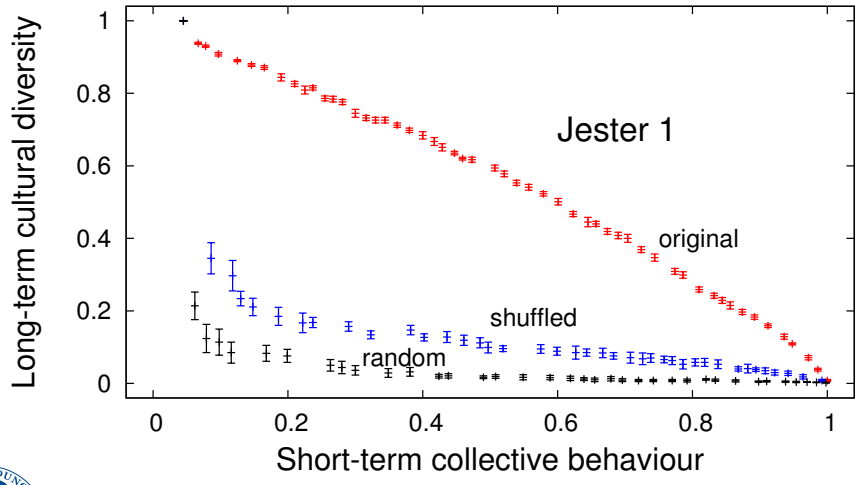
$$C(\omega) = \sqrt{\sum_A \left(\frac{S_A}{N}\right)^2_\omega}$$

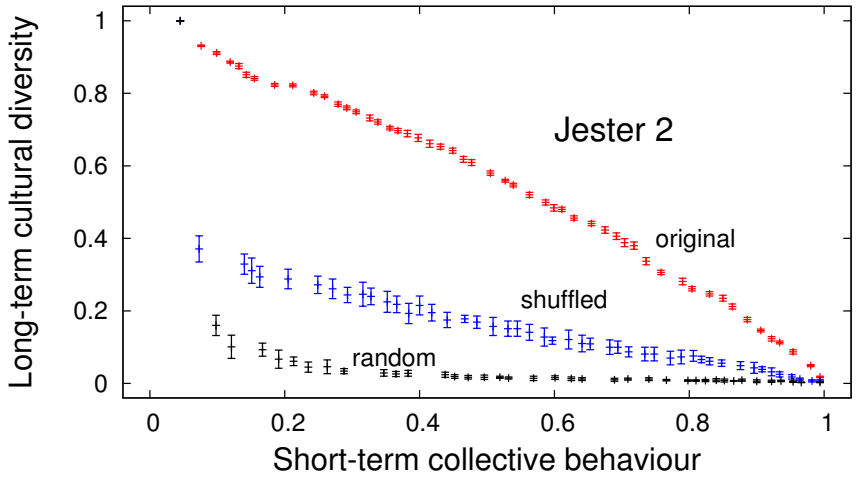
Valori et al (2012), PNAS **109**: 1068-1073.

Robustness across empirical data sets





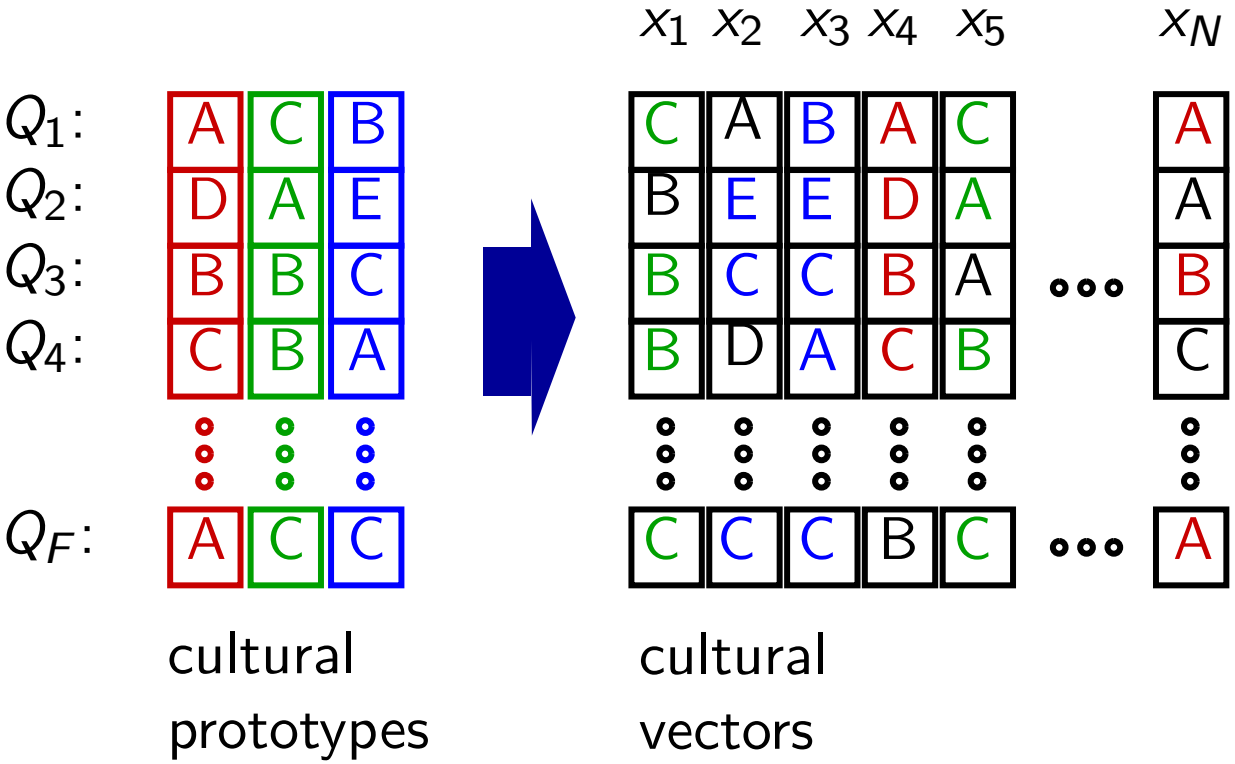




Babeanu et al (2014), in preparation.

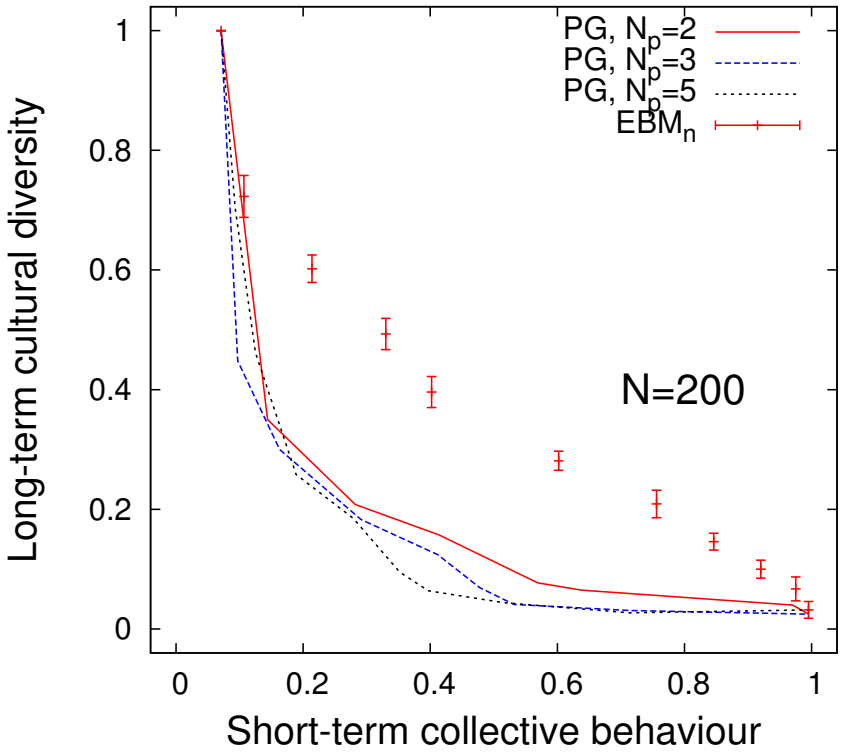
Prototype generation

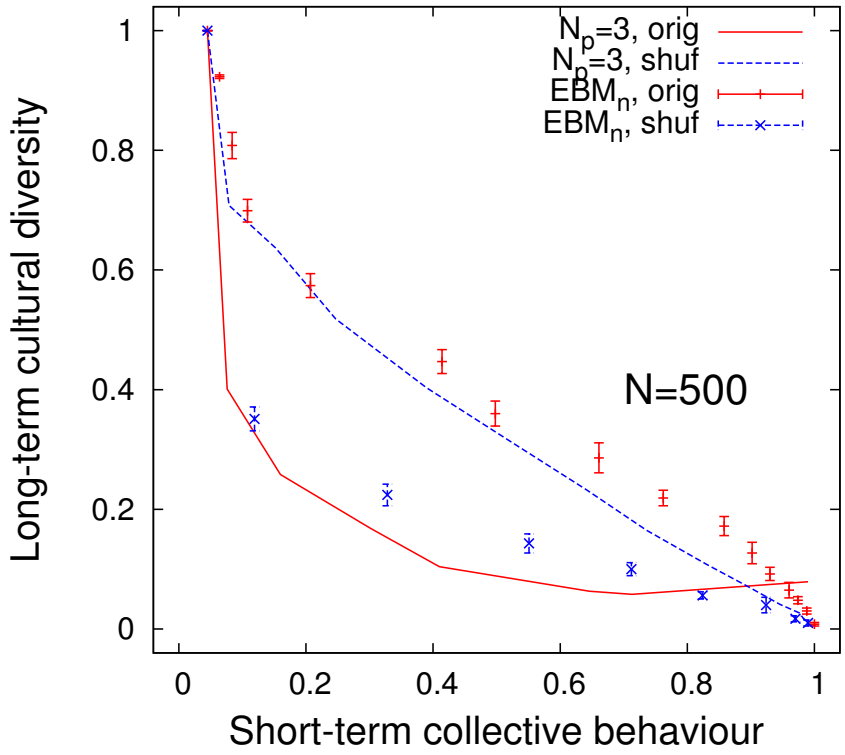
Valid for purely nominal data:



Stivala et al (2014), Sci. Rep. **4**:4870.

Evaluation of prototype generation





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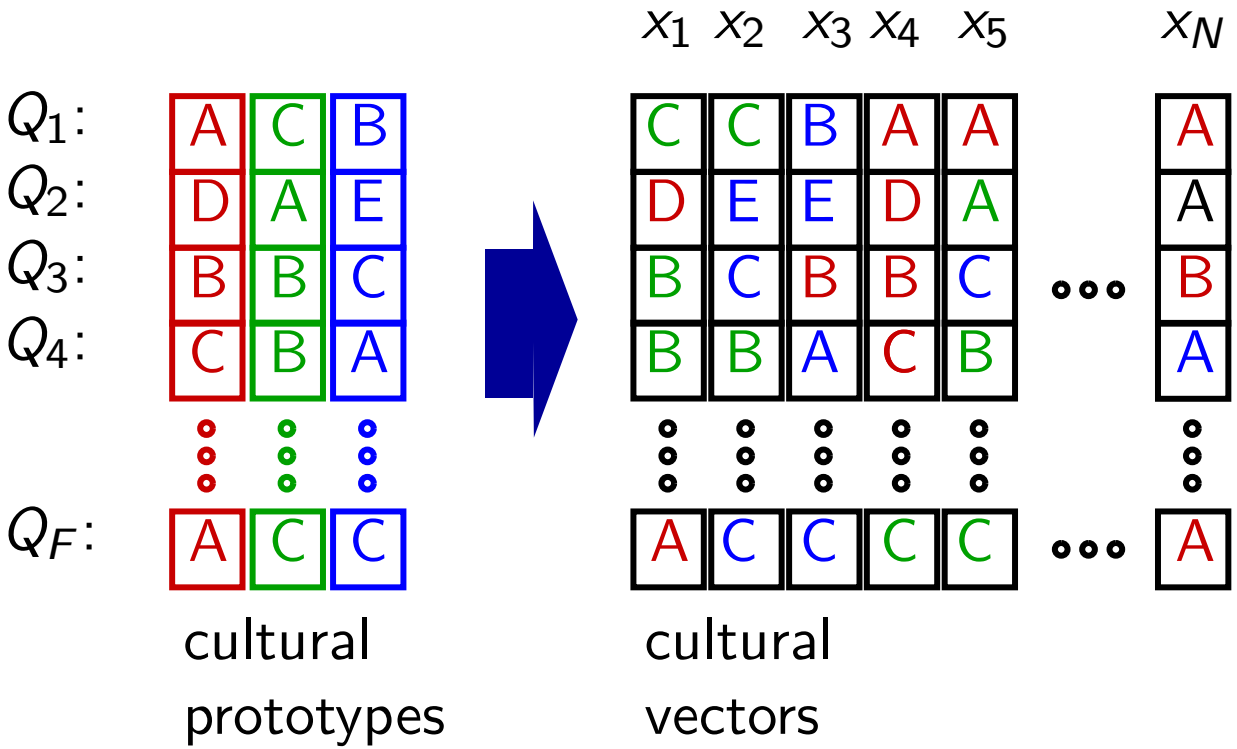
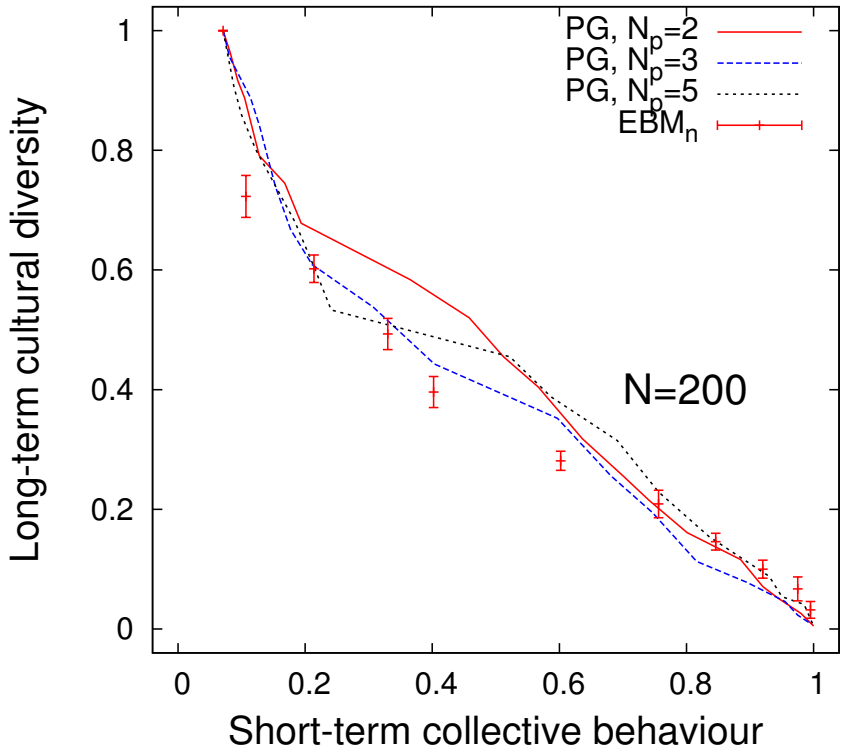
Mixed prototype generation

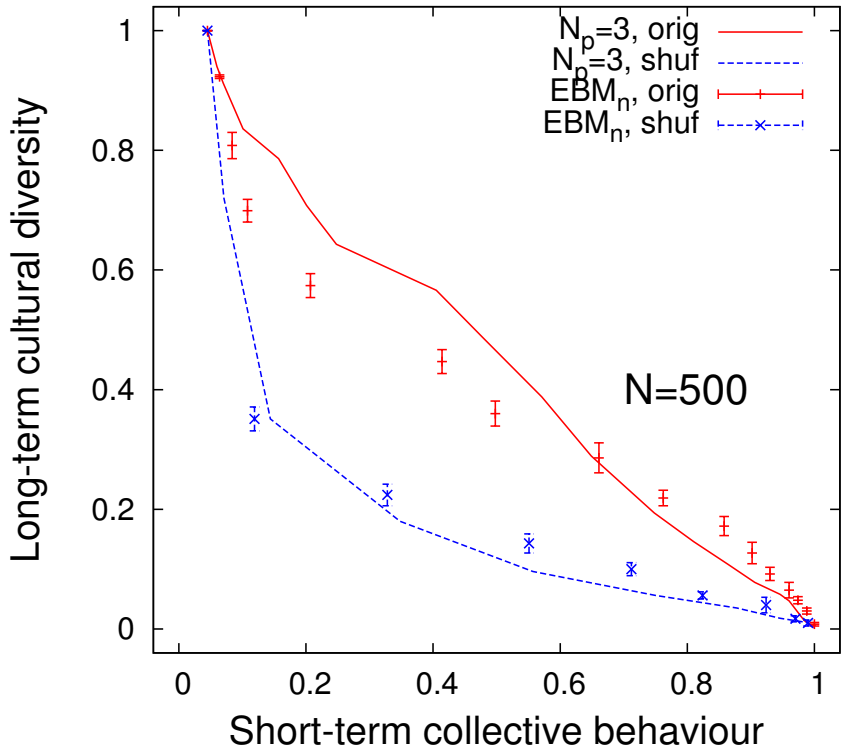
Valid for purely nominal data:



Babeanu et al (2014), in preparation.

Evaluation of mixed prototype generation





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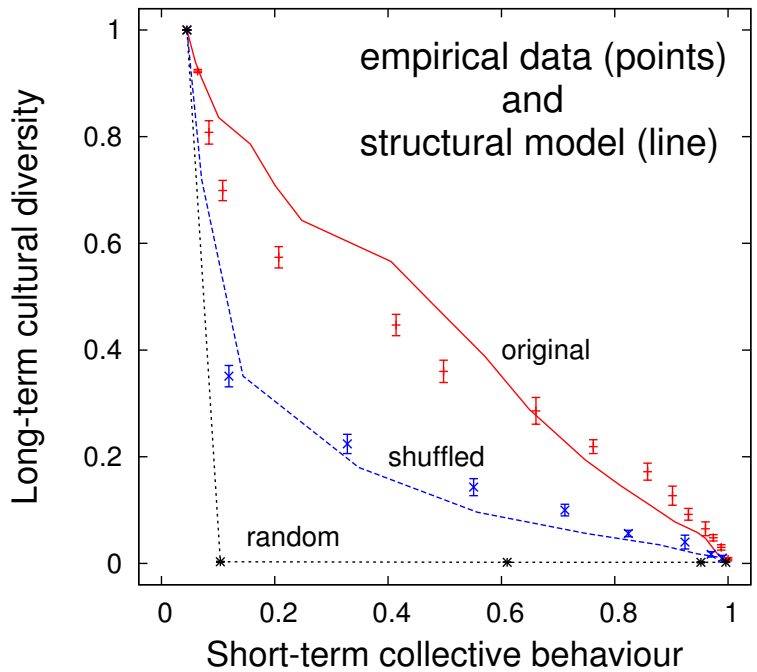
Conclusions

- results similar across empirical sources
- "mixed prototypes" hypothesis compatible
- ! generalize model to ordinal features
- ! become sensitive to number of prototypes
- ! more compact, computationally less intensive observables



Babeanu et al (2014), in preparation.

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