Kinship and reproduction in the historical population of the Krummhörn

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Introduction

- Human reproduction can be described as facultative cooperative breeding, i.e. mothers can benefit from allomaternal behavior and kin support provided by other family members (e.g. Reiches et al. 2009). Since patrilineal and matrilineal family members are exclusively related either to the mother or the father, kin selection theory suggests lineage-specific differences in kin effects between genetic relatives and in-laws.
- In this context, adaptive investment decisions might adress different reproductive outcomes, e.g. provided help could increase fertility, breeding success, and/or maternal surviva – one would also expect that trade-offs between these traits could conceal any fitness consequences if not adequately considered.
- Here, I test simulaneously for lineage-specific kin effects on age at first birth, interbirth intervals, and maternal survival (until day 42 postpartum and thereafter) using a multi-state event history approach (see Putter et al. 2007).

Spatiotemporal event histories and relatedness data

- The historical Population of the *Krummhörn*
  - ▷ fertile marsh region, in *East Frisia* (Germany)
  - ▷ well documented between 1720–1874 (vital events documented mainly in church books, socioeconomic data provided by tax lists) .
  - ▷ demographically saturated, socioeconomically stratified
- Geopositional data and a distance matrix can be accessed via public web services (e.g. ↪ Google Maps API)
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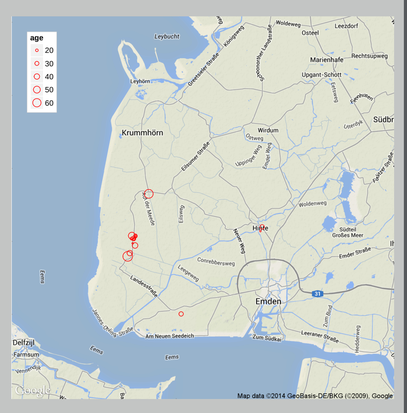
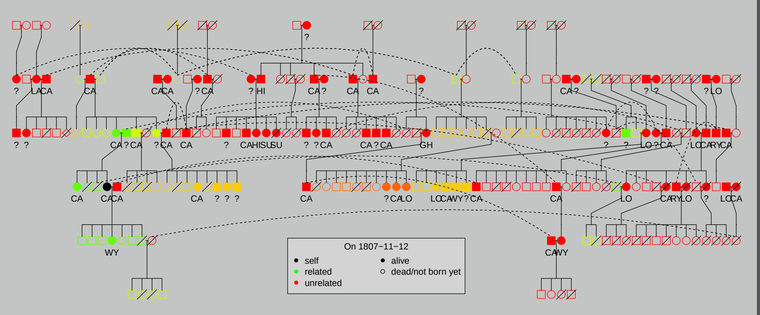


Pedigree example

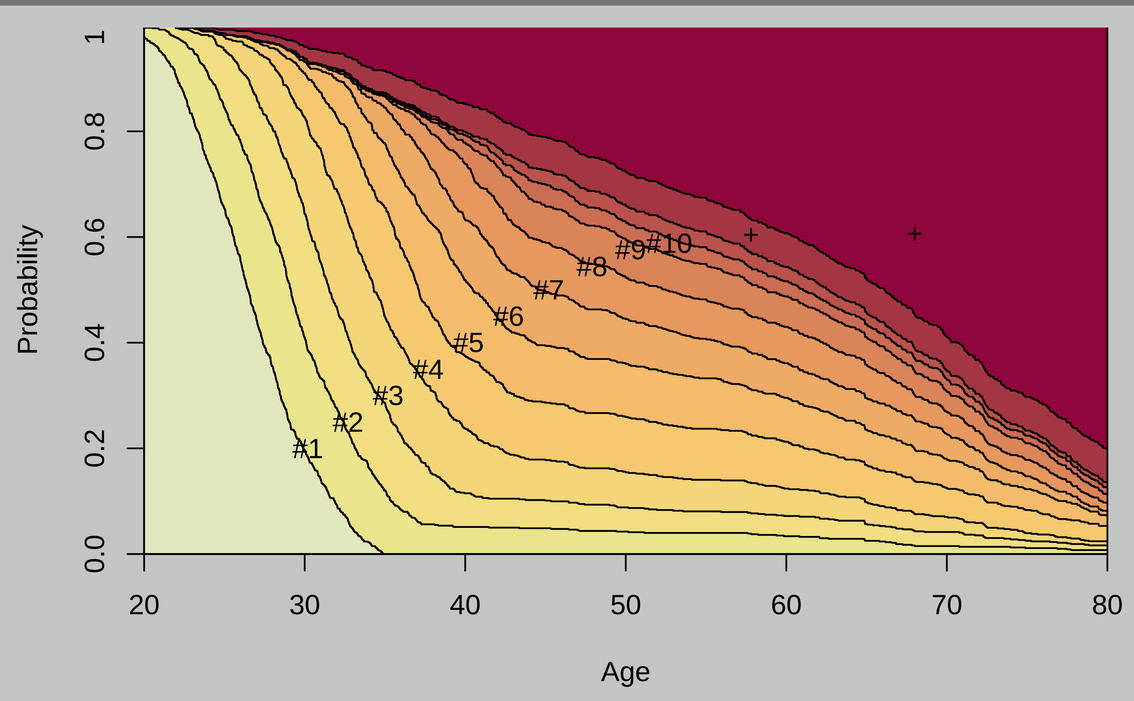
- Relatedness matrix for all family members
  - ▷ allows fast identification of kin and in-laws
  - ▷ leads to a sparse description of genetic relatedness



Methods and model specification (N = 1170 mothers)

- ▷ Kin and in-laws have been assumed as being available if living closer than 5 kilometres away from a mother.
- ▷ For each transition, included predictors were
  - genetic lineage (matrilineal or patrilineal) sex (♂or ♀)
  - age-category ('between 15 and 45' or 'over 45')
  - breeding status in the category 'between 15 and 45' ('with children' or 'childless')
- ▷ Period effects have been included as confounding variables (not shown)

Parity progression and maternal survival



Model estimates for genetic kin and in-laws

(15 yrs) ⇒ birth$_1$

	HR	*p*
landless	0.832	0.043
farmer	1.831	<0.001
♀, w. children	**0.843**	**<0.001**
♂15–45 yrs., childless	1.046	0.132
♂over 45 yrs.	1.089	0.036
♂over 45 yrs.	1.064	0.145
♂over 45 yrs.:farmer	0.656	0.009

birth$_x$ ⇒ birth$_{x+1}$

	HR	*p*
landless	0.894	0.027
farmer	1.134	0.045
last child ♀	2.311	<0.001
♀, w. children	1.136	0.001
♂15–45 yrs., childless	0.960	0.121
♀, w. children	1.289	<0.001
♀, over 45 yrs.	1.166	<0.001
♀, over 45 yrs.	1.207	<0.001
♂, over 45 yrs.	1.072	0.051
♀, w. children:last child ♀	0.825	0.013
♀, over 45 yrs.:last child ♀	0.870	0.002
♀, over 45 yrs.:last child ♀	0.841	<0.001
♂, over 45 yrs.:last child ♀	0.926	0.128

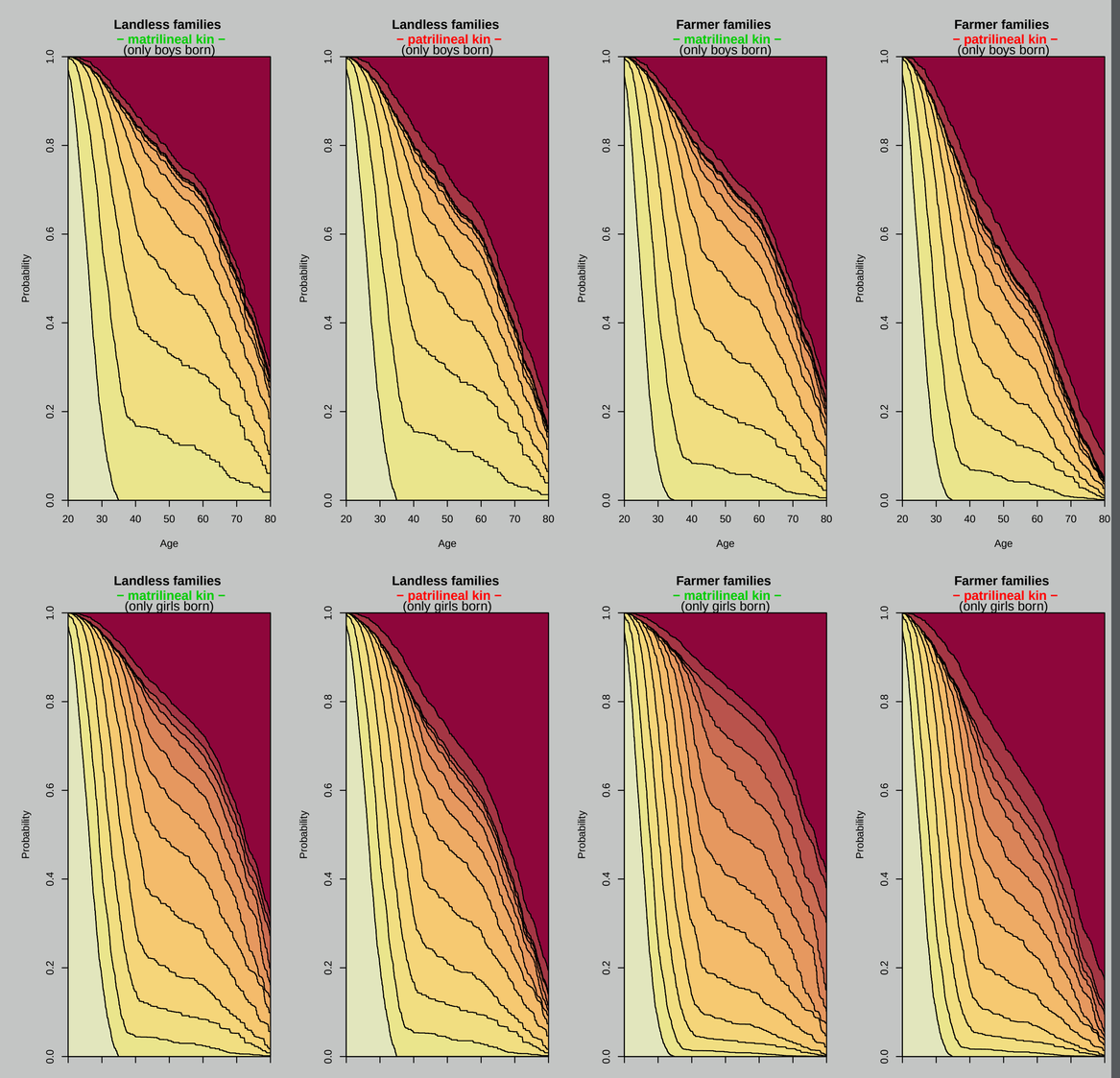
birth$_x$⇒ maternal death (<day 42)

	HR	*p*
♀, w. children	**3.460**	**0.023**
♀, w. children	0.220	0.178
♀, over 15 yrs.	0.542	0.007
♂, over 15 yrs.	0.484	0.007
♂, over 15 yrs.	0.545	0.000
♀, w. children:parity	0.878	0.066
♀, w. children:parity	1.160	0.011

birth$_x$⇒ later death (>day 42)

	HR	*p*
landless	1.025	0.807
farmer	1.623	0.015
♀born	0.759	0.071
farmer:♀born	0.666	0.115
♀, over 15 yrs.	0.961	0.421
♂, over 15 yrs.	0.639	0.001
♀, over 15 yrs.	0.878	0.238
♂, over 15 yrs.	0.755	0.007
landless:♀, over 15 yrs.	0.816	0.137
farmer:♀, over 15 yrs.	0.700	0.059
♀born:parity	1.016	0.079
parity:♂, over 15 yrs.	1.019	0.004
parity:♀, over 15 yrs.	1.010	0.093
parity:♂, over 15 yrs.	1.010	0.078

Simulation runs showing conditional, lineage-specific kin effects



Conclusions

- Cobreeding, patrilineal sisters-in-law are costly to a mother in terms of delayed reproduction and reduced survival.
  - ▷ Interaction effects with socioeconomic indicators suggest conditional behavioral strategies
- Sex-dependent effects do suggest X-chromosomal relatedness could also be relevant (e.g. Fox et al. 2011).

References

- **Fox, et al. (2011)**, *Int J Evol Biol*, http://dx.doi.org/10.4061/2011/165919.
- **Putter, et al. (2007)**, *Stat In Med*, http://dx.doi.org/10.1002/sim.2712.
- **Reiches, et al. (2009)**, *Am J Hum Biol*, http://dx.doi.org/10.1002/ajhb.20906.
- **Therneau, et al. (2014)**, *kinship2 R pkg*, http://CRAN.R-project.org/package=kinship2.

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