Maternal and social genetic effects on growth of piglets from birth till weaning

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Introduction

- Social interactions due to:
  - competition for limited resources
  - social behavior

  (Muir, 1996 & 2005)

- Consequences for selection response
  (Muir, 2005; Bijma et al. 2007)

- Heritable social effects found for growth of finishing pigs
  (Arango et al. 2005; Bergsma et al. 2008; Chen et al. 2008; Chen et al. 2009)

Introduction

Social interactions between piglets in period from birth till weaning

- Milk is a limiting resource
- Teat order

(e.g. Hodge, 1974; Hartsock and Graves, 1976; Fraser 1980; Fraser and Thompson 1986; Harrell et al. 1993;)

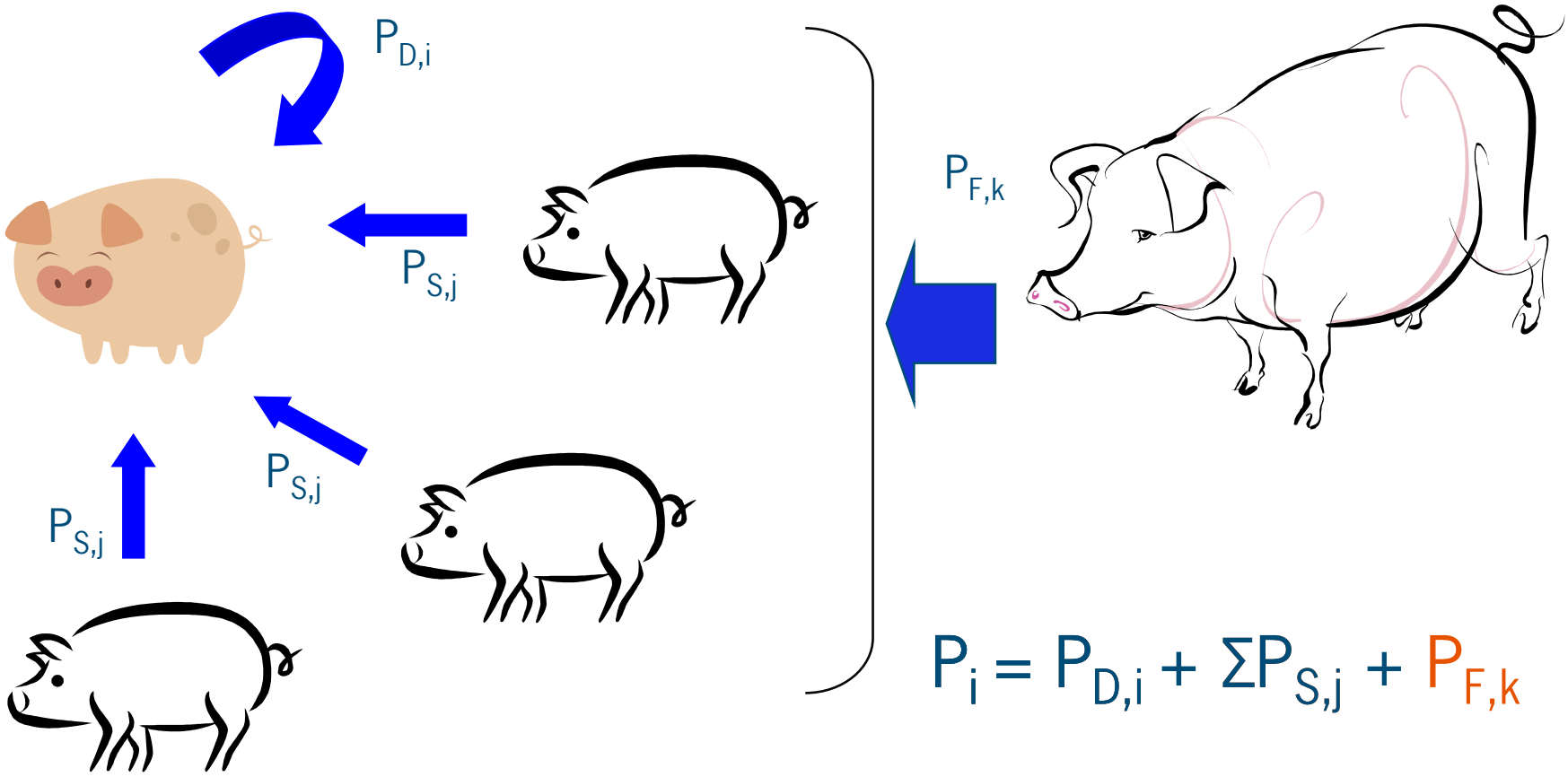
Aim

- Is there heritable social variation in growth of piglets?
- Extend the social interaction model with a maternal effect
- Compare models:
  - basic animal model
  - social model
  - maternal model
  - social-maternal model

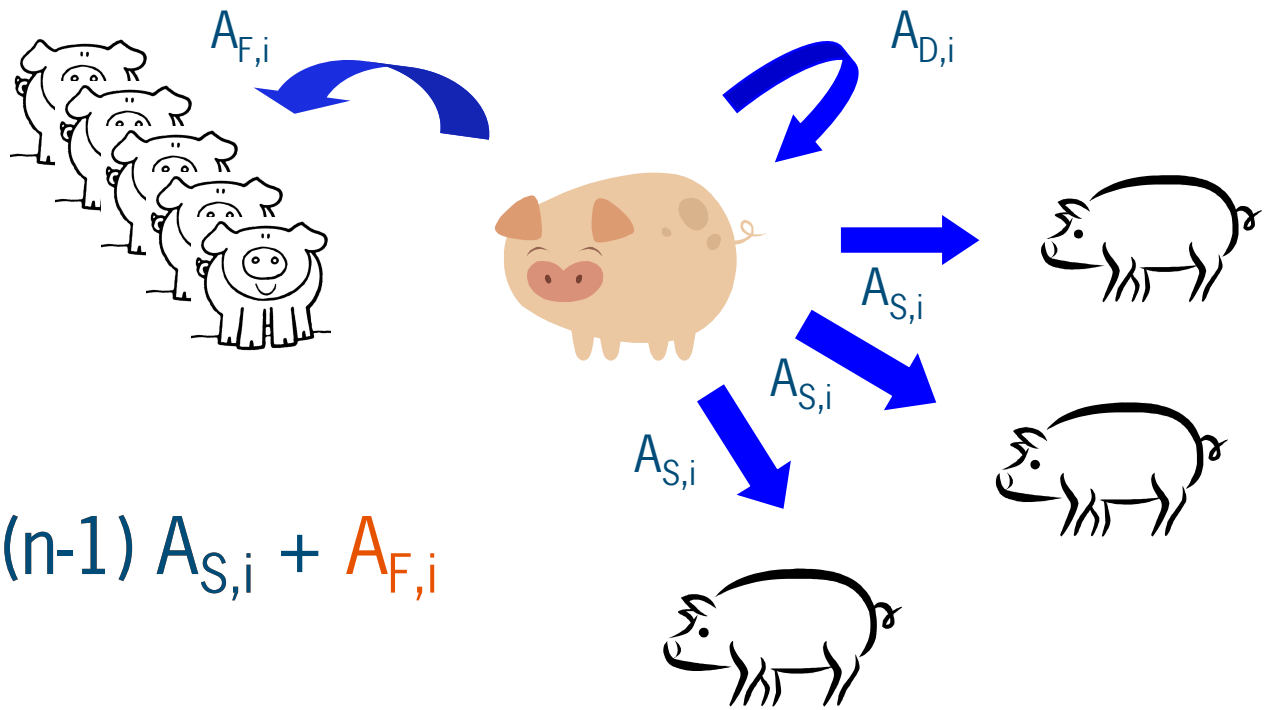
Data

- # piglets: 17,053
- # (foster) groups: 1,604
- Pedigree: 49,645 (5 generations)
- Average group size: 10.8 (range 7-14)
- Cross-fostering %: 28.8%
- Average growth: 251 g/day (sd=61)

Background



Total breeding value



$$TBV_i = A_{D,i} + (n-1)\,A_{S,i} + A_{F,i}$$

Total heritable impact an individual can have on the population

Models

- 1_{basic}: $\mathbf{y = Xb + Z_D a_D +} \quad \mathbf{Wc + Vg + Upe + e}$
- 2_{social}: $\mathbf{y = Xb + Z_D a_D +} \quad \mathbf{Z_S a_S + Wc + Vg + Upe + e}$
- $3_{maternal}$: $\mathbf{y = Xb + Z_D a_D + Z_F a_F +} \quad \mathbf{Wc + Vg + Upe + e}$
- $4_{social\text{-}maternal}$: $\mathbf{y = Xb + Z_D a_D + Z_F a_F + Z_S a_S + Wc + Vg + Upe + e}$

c: **c**ommon birth litter = common env. in uterus of biological dam

g: **g**roup = common postnatal env. due to being in same (foster) litter

pe: **p**erm. **e**nv. from foster dam = 75% fostered 2/more litters

Results

Model	h^2_D	h^2_S	h^2_F	c^2	g^2	pe^2	T^2
1_{basic}	0.07	-	-	0.05	0.10	0.09	0.07
2_{social}	0.07	$0.0009_{0.0005}$	-	0.05	0.09	0.08	0.11
$3_{maternal}$	0.07	-	0.06	0.06	0.09	0.04	0.10
$4_{social\text{-}maternal}$	0.07	$0.0007_{0.0005}$	0.06	0.05	0.09	0.03	0.15

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Results

$$T^2 = \sigma^2_{TBV} / \sigma^2_P$$

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Results

Log Likelihood

Model	LogL
1_{basic}	-8600
2_{social}	-8597
$3_{maternal}$	-8592
$4_{social\text{-}maternal}$	-8590

Likelihood-ratio tests (Chi^2 - distribution)

Models	P-value
1_{basic} vs 2_{social}	0.074
1_{basic} vs $3_{maternal}$	<0.001
2_{social} vs $4_{social\text{-}maternal}$	0.004
$3_{maternal}$ vs $4_{social\text{-}maternal}$	0.385

Conclusion model $3_{maternal}$ performs best

Remarks

- Foster dam as maternal effect
  - Both biological and foster dam as genetic effect
    - unsuccessful in convergence → not separable
  - Genetic effect foster dam > genetic effect biological dam
- Non genetic terms
  - Without **common**: **direct** genetic effect increased (+social)
  - Without **group**: genetic **foster + social** effect increased
  - Without **perm. env.**: genetic **foster** effect increased (+social)

Conclusion

- Separation of heritable direct, social & foster effect is possible when substantial cross-fostering is applied
- No evidence that growth in the period from birth till weaning was affected by genetic social interactions
- Maternal model performed best

Acknowledgement

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