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**Agroscope**

# Genetic parameters for genetic variance uniformity in Swiss pigs' birth weight

**Claudia Kasper, Alfredo Lepori, Juan-Pablo Gutiérrez, Nora Formoso-Rafferty, Ewa Sell-Kubiak, Isabel Cervantes**

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# Heterogeneity in birth weight in pigs

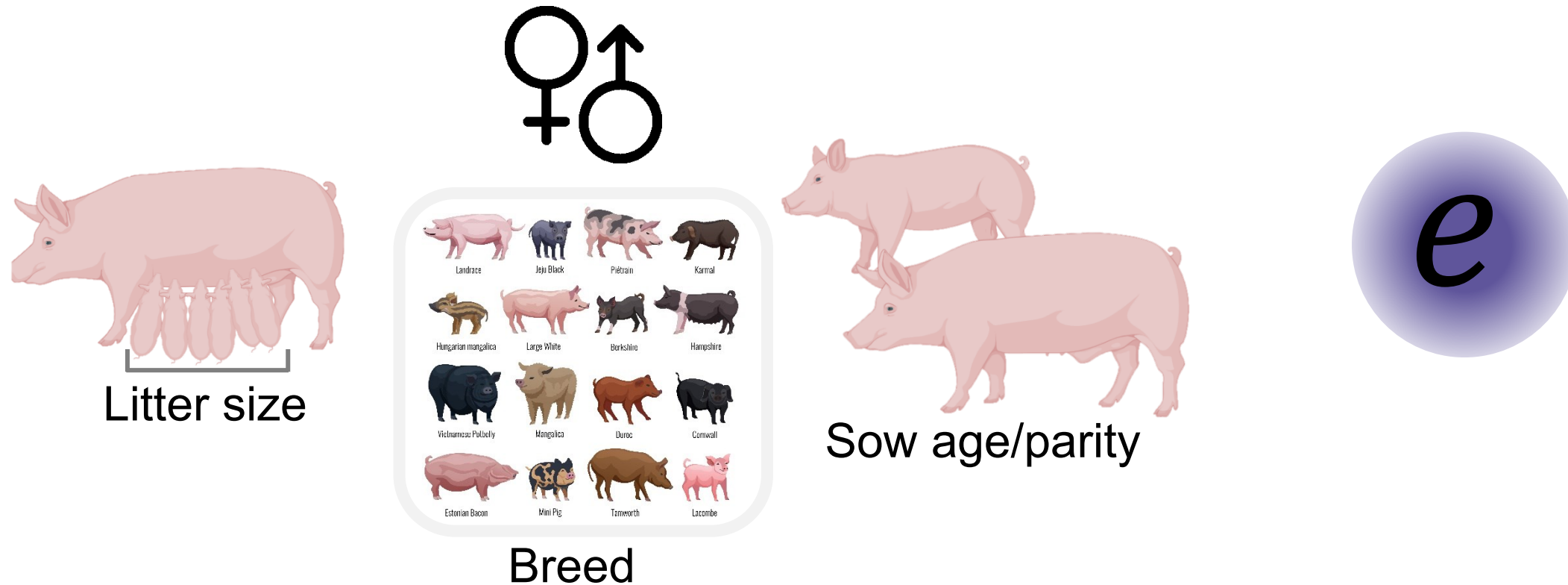
Selection for **increased litter size** → higher within-litter **heterogeneity** of birth weights

- Higher perinatal mortality
- Higher variation in weaning weight and age at slaughter
- Management challenges:
  - cross-fostering
  - match piglets according to weight – immunity concern

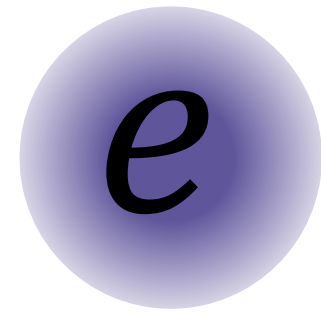


# 🇨🇭 Heterogeneity in birth weight in pigs

## Factors influencing birth weight



# 🇨🇭 Heterogeneity in birth weight in pigs



## Breeding

*“Genetic control of environmental/residual variance”* (Formoso-Rafferty et al., 2015; de Souza lung et al., 2019)

Homogeneity ~ *robustness* (Rönnegard et al., 2010; Fathallah et al., 2016)

## Mouse as model

*What can be expected when selecting for increased homogeneity?*

(Formoso-Rafferty et al., 2015)



Low-variability line

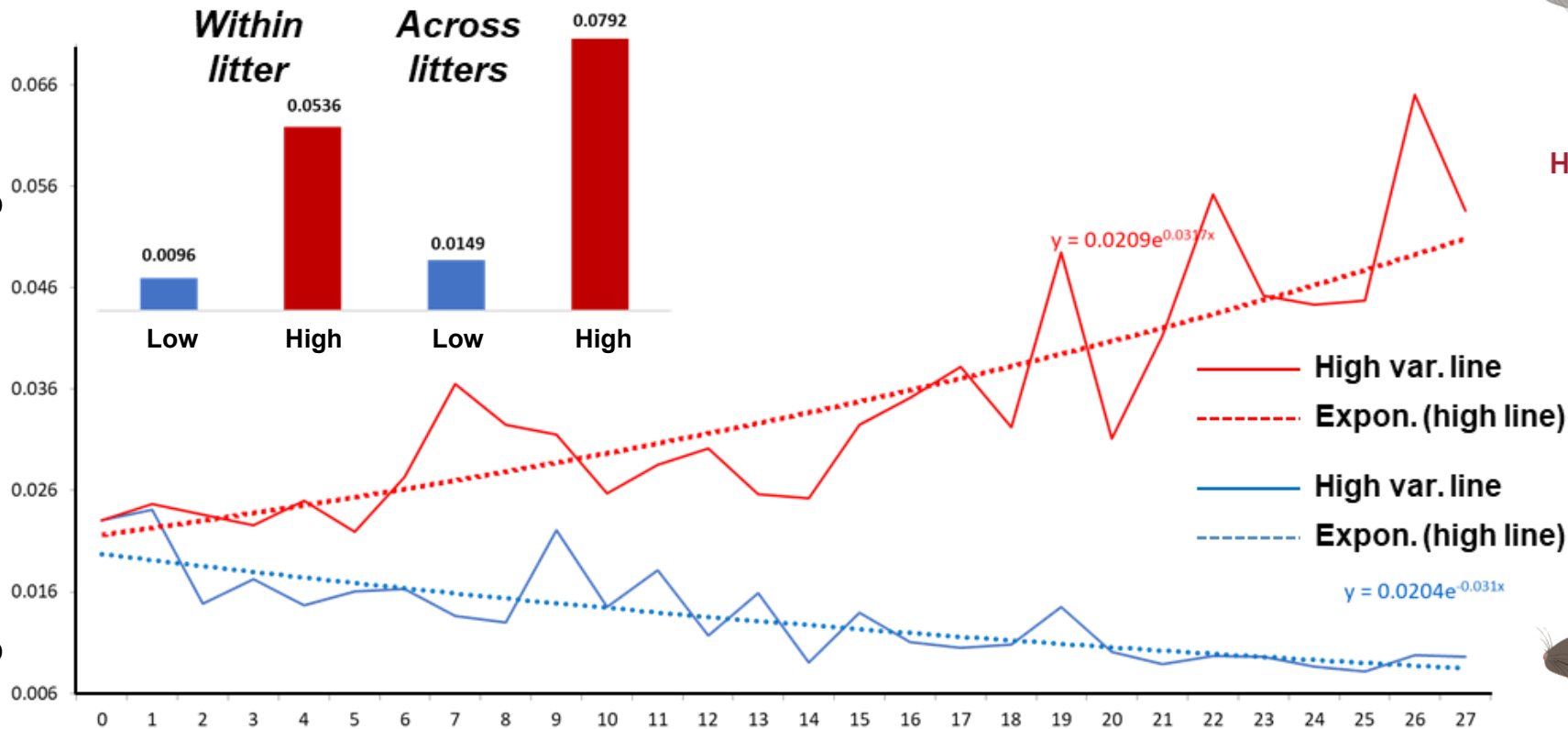


High-variability line

# 🇨🇭 Heterogeneity in birth weight in mice

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Average within-litter birth weight variance



High-variability line

Low variability line:

- Higher survival
- Larger litter size
- Higher reproductive longevity



Low-variability line

# Data set

- 2 commercial farms
- Free farrowing
- Suisag
- Individual birth weights ( $\leq 24$  hrs of birth)
- 24,720 piglets, 1,744 litters, 813 SOWS
- Pedigree: 27,285 individuals





# 🇨🇭 Homoscedastic vs. heteroscedastic model

- Assumption: residual variance is not homogeneous
  - different for each level of random and systematic effect
- **Homoscedastic** → **heteroscedastic** model (GSEVM software)

$$y_i = x_i b + z_i a + w_i c + e_i \rightarrow y_i = x_i b + z_i a + w_i c + e^{1/2(x_i b^* + z_i a^* + w_i c^*)} \varepsilon_i$$

“Genetic control of residual variance”

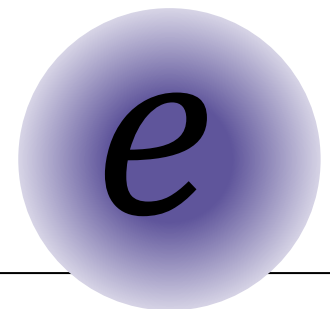
\* environmental variability correlation  $\rho$

**b: systematic** (fixed) effects:

- **Sex** (male or female)
- **Survival at weighing** (alive/dead)
- **Age of the sow** (from 300 to 1956 days)
- **Farm \* Month \* Year** (75 levels)
- **Litter Size** (17 levels: 2-5, 6, 7... 20, >20)
- **Breed** (4 levels)

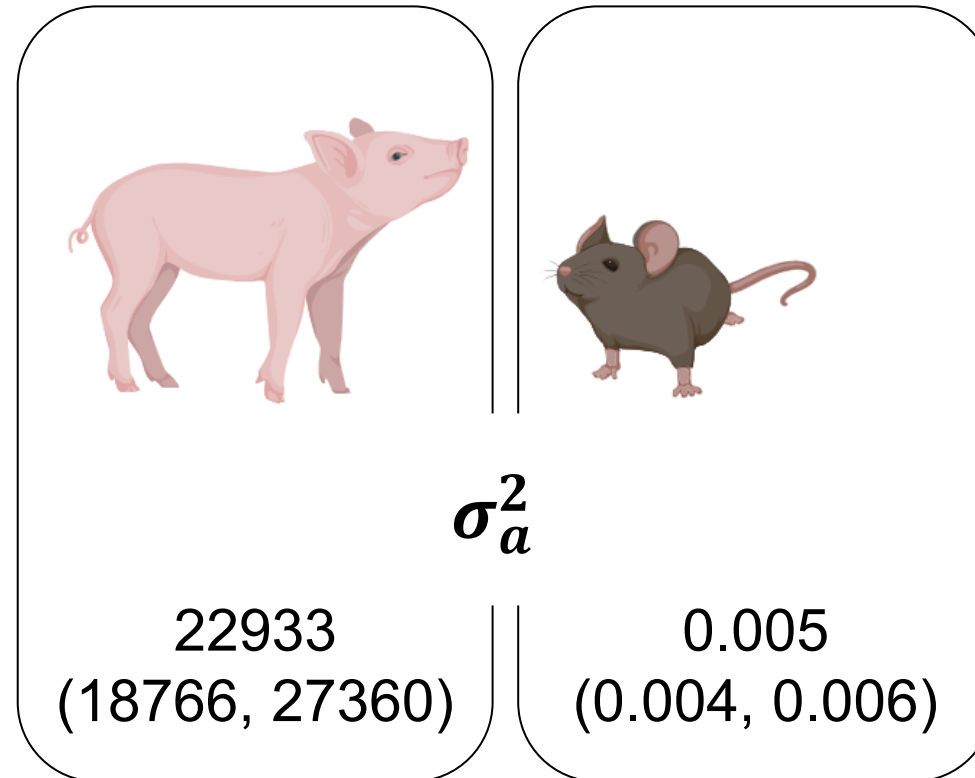
**random effects**

- a:** sow genetic effects
- c:** litter effects



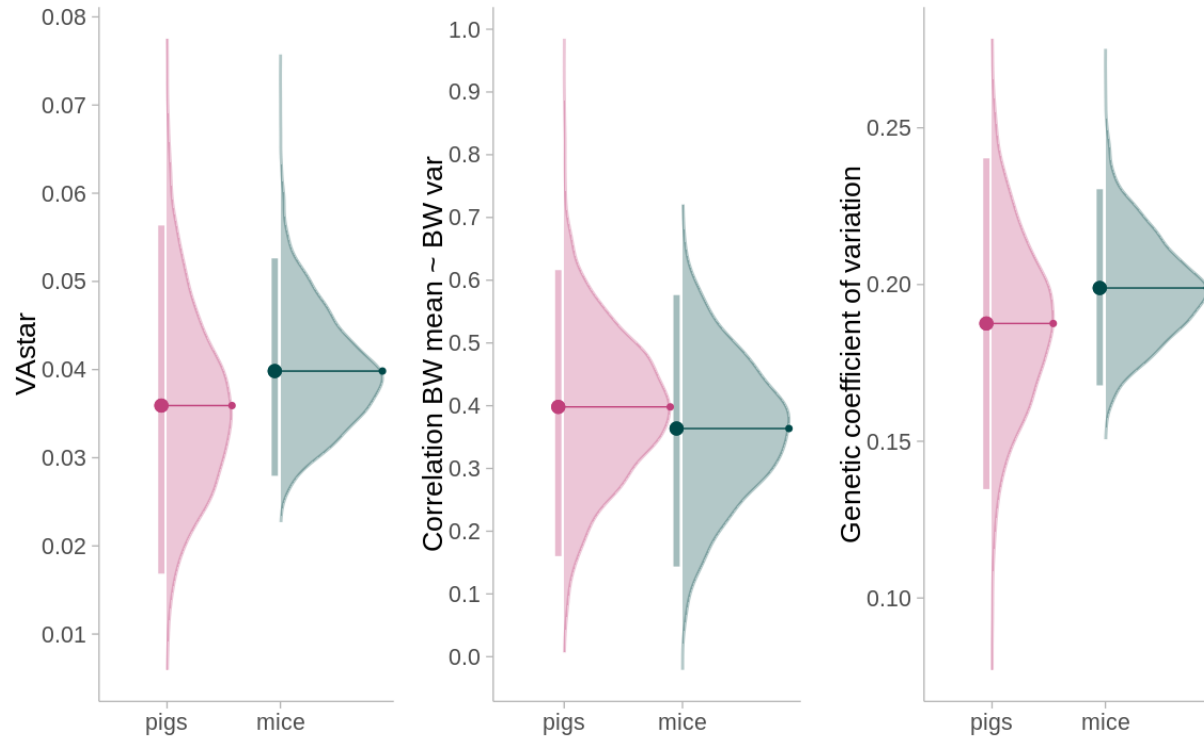
# Genetic parameters

in **pigs** and **mice**





# Genetic parameters

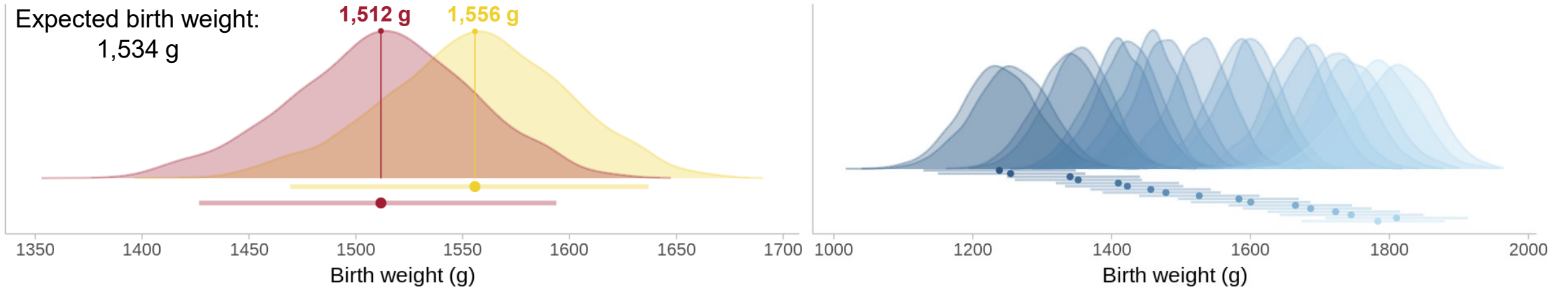


|                        | $\sigma_{a*}^2$         | $\rho$                  | GCV                     |
|------------------------|-------------------------|-------------------------|-------------------------|
| <b>Pigs</b><br>95% CrI | 0.036<br>(0.018, 0.057) | 0.398<br>(0.166, 0.622) | 0.187<br>(0.135, 0.240) |
| <b>Mice</b><br>95% CrI | 0.040<br>(0.028, 0.052) | 0.364<br>(0.144, 0.576) | 0.199<br>(0.167, 0.229) |

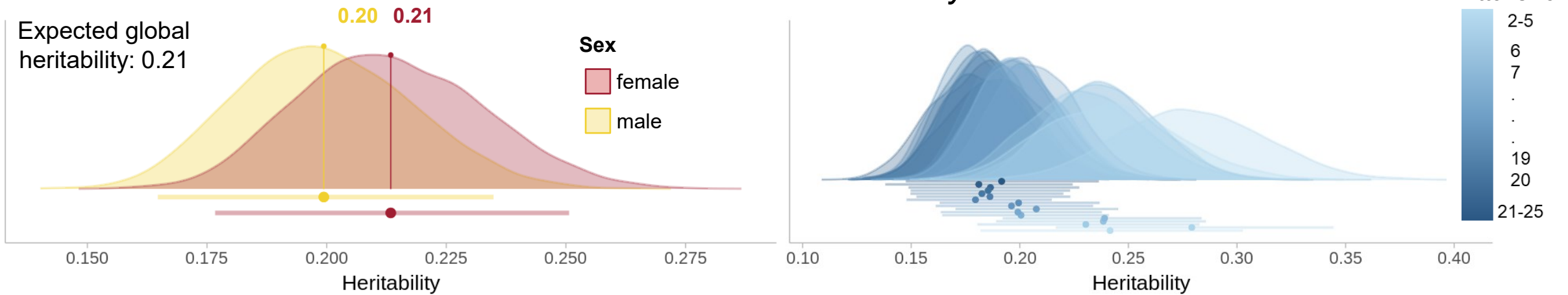
Clau  
Gene

# Effect of sex and litter size...

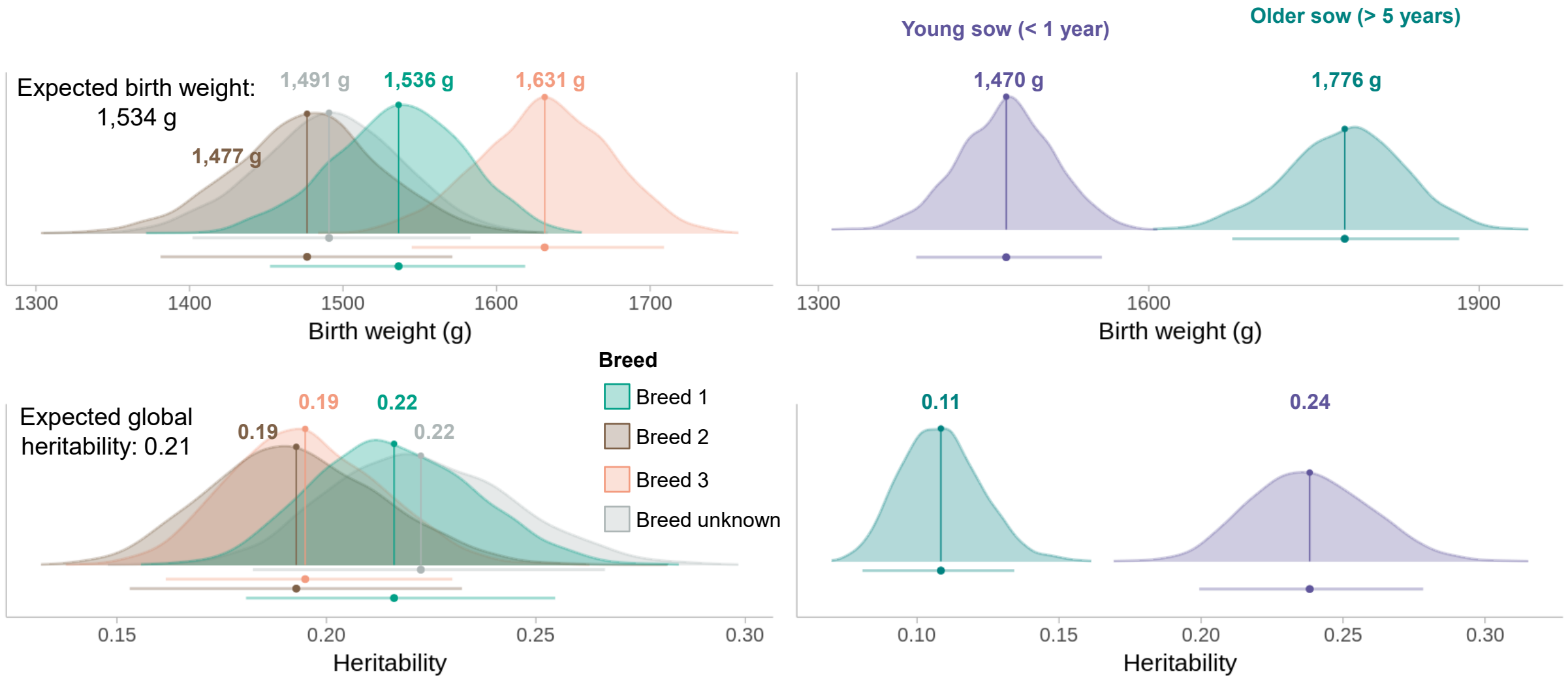
...on birth weight



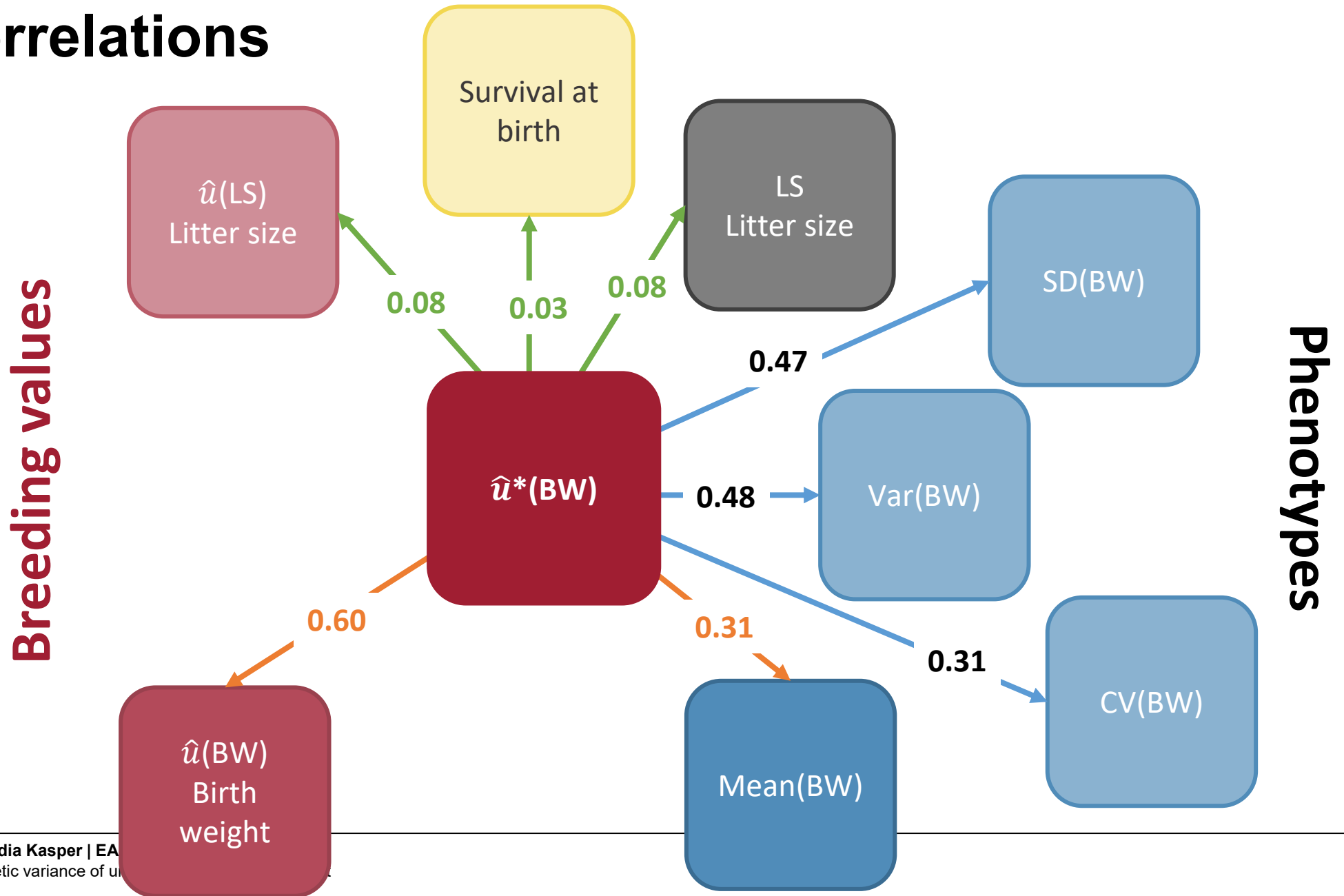
...on its heritability



# Effect of breed and age of sow...



# Correlations



# Conclusions

- **Potential for breeding**
- Similarity to mice, where breeding was successful
- Positive genetic **correlation of variability with mean**
  - unfavourable, but **survival not affected** (or even increased)
- «optimal birth weight» – «intermediate piglet»?

### Breeding for uniformity in piglet birth weight to improve survival

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#### Background

Selection for **uniformity** in birth weight could lead to a more ethical and efficient livestock production because it results in more **robust animals**, which are easier to manage, more feed-efficient and are more likely to survive to weaning.

#### Objective

Estimate the genetic component of residual variance for birth weight and its relationship with piglet survival in a Swiss experimental farm.

#### Material and Methods

**Data set:** 43,135 records of BW from 3,163 litters of 986 sows



 **Thank you!**

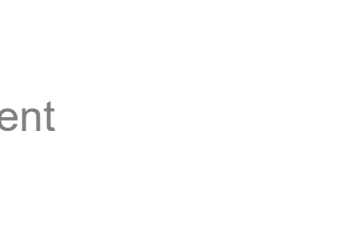
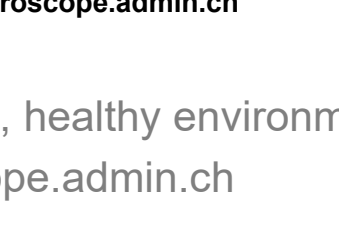
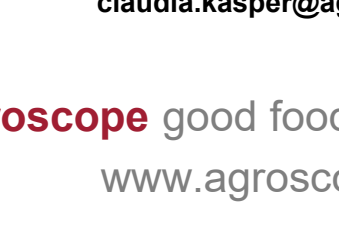
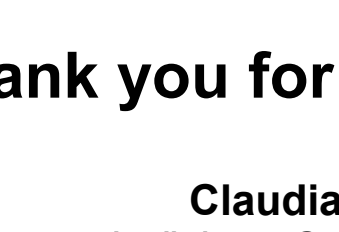
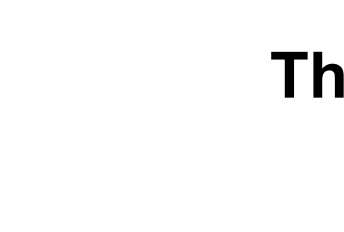
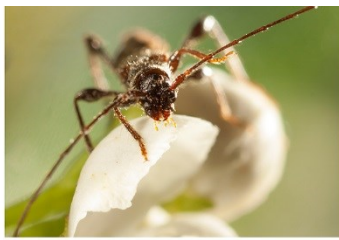


Data collection and sharing



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**Thank you for your attention**

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