

Separating genomic imprinting effects and maternal effects in birth weights in Large White pigs

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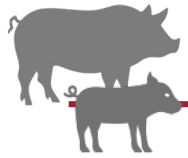


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What are Parent-of-origin effects?



Maternal Effects

Offspring's phenotype is influenced by the mother's environment



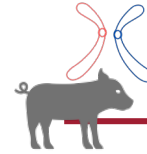
uterine environment



suckling behaviour



milk yield



Genomic Imprinting

Each inherited allele of a gene is expressed according to its parental origin



Histone modification



Variable replication timing



RNA – mediated effects



DNA – methylation



Parent-of-origin effects

- birth weights of piglets

Birth weights are important for survival and homogenous growth of litters, where maternal effect and genomic imprinting seem to influence the expression of the trait.



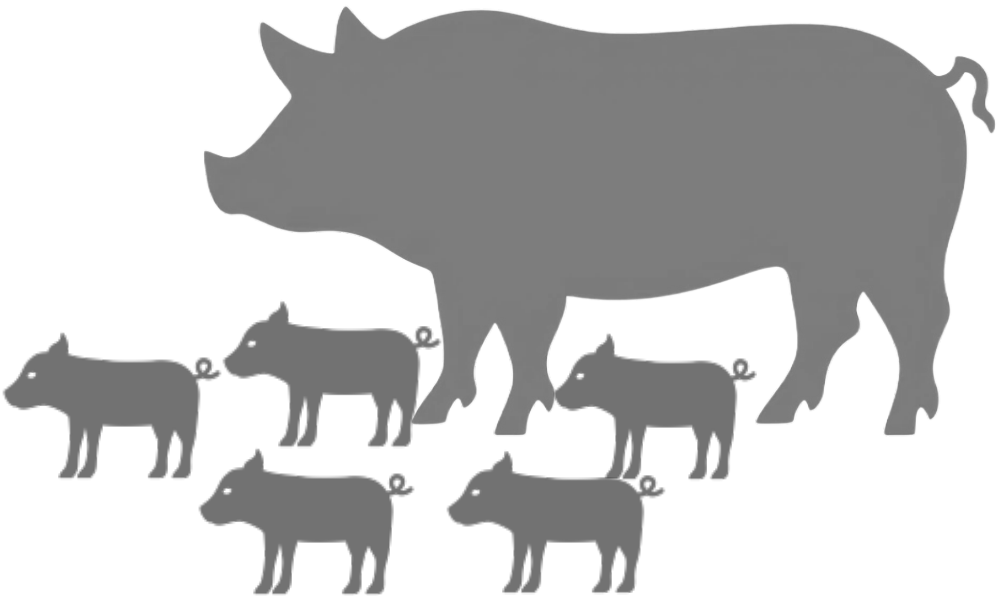


Objective

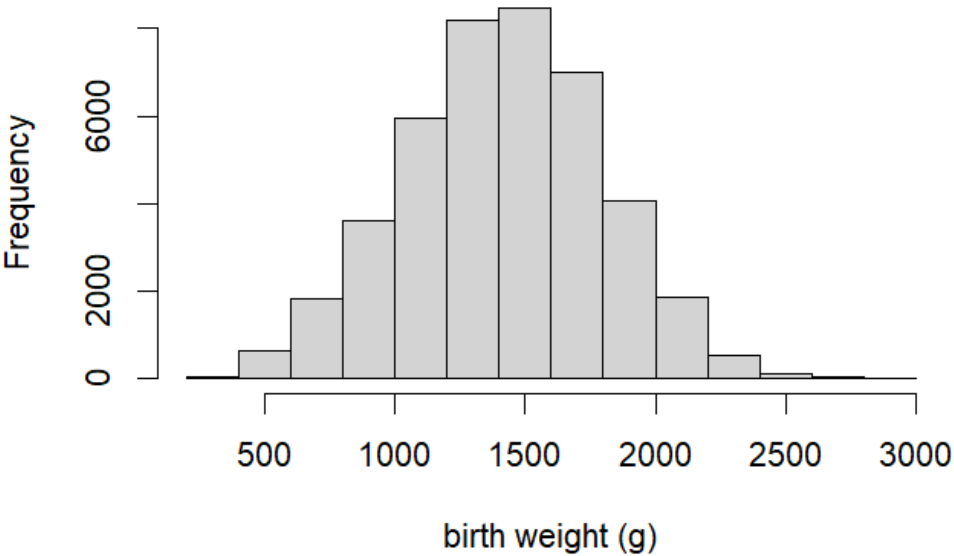
**To investigate the possibility
to separate maternal effects
and genomic imprinting
effects in birth weights**



Birth weights of Large White Piglets



<i>Pedigree size</i>		<i>49,734</i>	
<i>Sows</i>	<i>946</i>	<i>300</i>	<i>Boars</i>
<i>Piglets</i>		<i>42,367</i>	
<i>Litter</i>		<i>3,156</i>	
<i>Litter size</i>	<i>14.69 (3.4)</i>	<i>12</i>	<i>Parity</i>

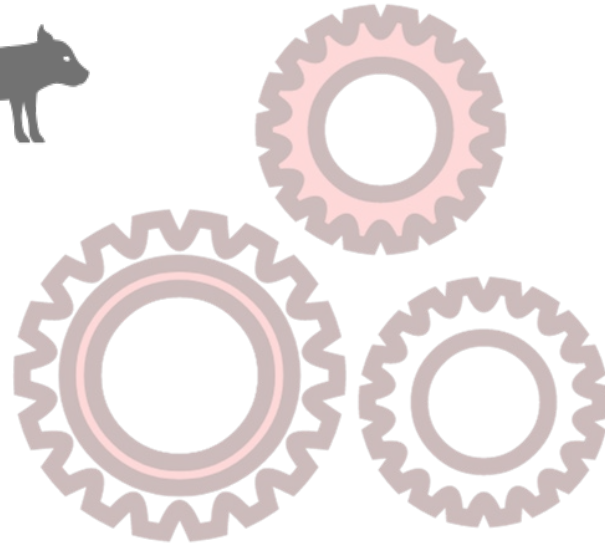
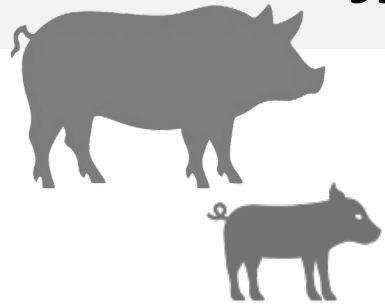


Models

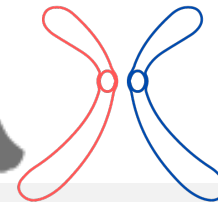
***Animal
Model
(AM)***



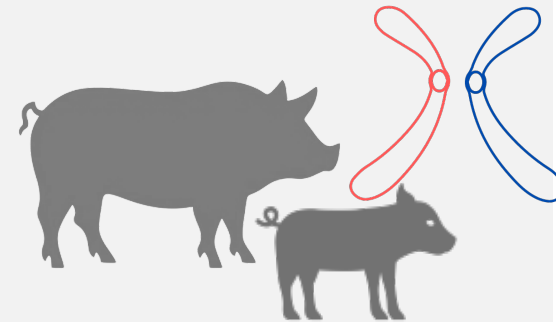
Maternal Effects Model (MM)



Imprinting Model (IM)



***Maternal Effects
Imprinting
Model
(MIM)***



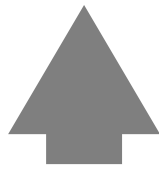
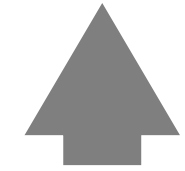
Generalized maternal effects - imprinting model

- birth weights (first parity sows)

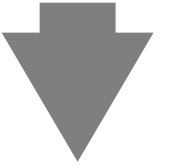
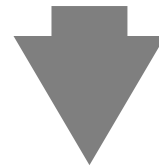
Birth weights

Maternal effects

Gametic effects as dam



$$y = Xb + Zm + Za_s + Za_d + e$$



Contemporary group, litter size, sex

Gametic effects as sire

Residual effects

Computing Genetic Parameter – birth weights

$$\mathbf{G} = \begin{bmatrix} \sigma_d^2 & \sigma_{d,s} & \sigma_{d,m} \\ \sigma_{s,d} & \sigma_s^2 & \sigma_{s,m} \\ \sigma_{m,d} & \sigma_{m,s} & \sigma_m^2 \end{bmatrix}$$

Computing Genetic Parameter – birth weights

$$\mathbf{G} = \begin{bmatrix} \sigma_d^2 & \sigma_{d,s} & \sigma_{d,m} \\ \sigma_{s,d} & \sigma_s^2 & \sigma_{s,m} \\ \sigma_{m,d} & \sigma_{m,s} & \sigma_m^2 \end{bmatrix}$$

Heritability:

$$h_{direct}^2 = \frac{(\sigma_d^2 + \sigma_s^2)}{(\sigma_d^2 + \sigma_s^2 + \sigma_{d,m} + \sigma_{s,m} + \sigma_m^2 + \sigma_e^2)}$$

$$h_{maternal}^2 = \frac{\sigma_m^2}{(\sigma_d^2 + \sigma_s^2 + \sigma_{d,m} + \sigma_{s,m} + \sigma_m^2 + \sigma_e^2)}$$

$$h_{total}^2 = \frac{(\sigma_d^2 + \sigma_s^2 + \frac{3}{2}(\sigma_{d,m} + \sigma_{s,m}) + \frac{1}{2}\sigma_m^2)}{(\sigma_d^2 + \sigma_s^2 + \sigma_{d,m} + \sigma_{s,m} + \sigma_m^2 + \sigma_e^2)}$$

Relative imprinting variance:

$$i^2 = \frac{(\sigma_d^2 + \sigma_s^2 - 2\sigma_{d,s})}{(\sigma_d^2 + \sigma_s^2 + \frac{3}{2}(\sigma_{d,m} + \sigma_{s,m}) + \frac{1}{2}\sigma_m^2)}$$

Significance of parent-of-origin effects in birth weights

<i>Log Likelihood Ratio Test (P Value)</i>		<i>Alternative Hypothesis</i>		
		Imprinting Model	Maternal Effects Model	Maternal Effects Imprinting Model
<i>Null Hypothesis</i>	Animal Model	<0.001	<0.001	<0.001
	Imprinting Model	-	-	0.004

Genetic Correlations

Gametic variance as dam		
0.87	Gametic variance as sire	
-0.59	-0.14	Maternal variance

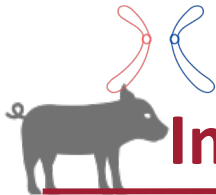


Models



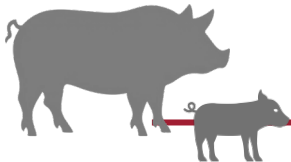
Animal Model

Heritability: 0.56



Imprinting Model

Heritability	Relative imprinting variance
0.63	0.60



Maternal Effects Model

Heritability		
direct	maternal	total
0.021	0.23	0.06

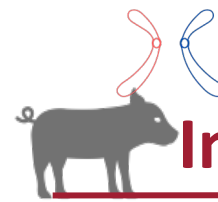


Models



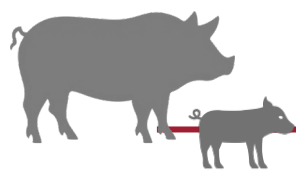
Animal Model

Heritability: 0.56



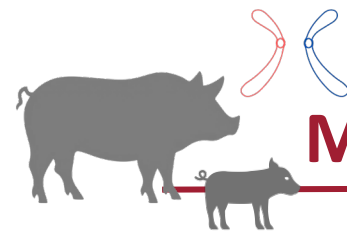
Imprinting Model

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Maternal Effects Model

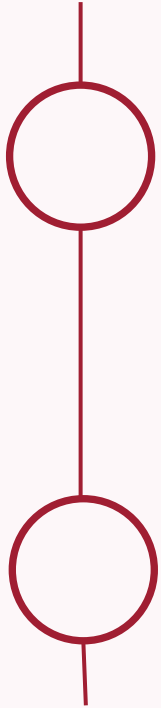
Heritability		
direct	maternal	total
0.021	0.23	0.06



Maternal Effects Imprinting Model

Heritability			Relative imprinting variance
direct	maternal	total	
0.31	0.30	0.35	0.27

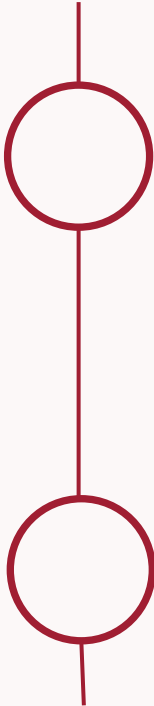
Take Home Messages



Both Maternal effects and genomic imprinting influence the birth weights in Large White piglets

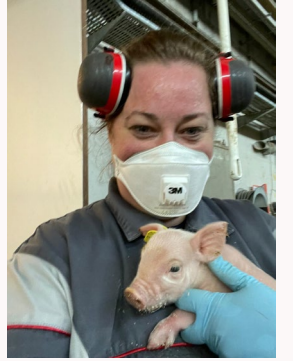
Confounding of effects might happen if not accounted for

Take Home Messages



Both Maternal effects and genomic imprinting influence the birth weights in Large White piglets

Confounding of effects might happen if not accounted for



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Thank you

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