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Genetic parameters for potential auxiliary traits for lameness based on data from PLF-technologies

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What is it about?

Precision livestock technology on farms

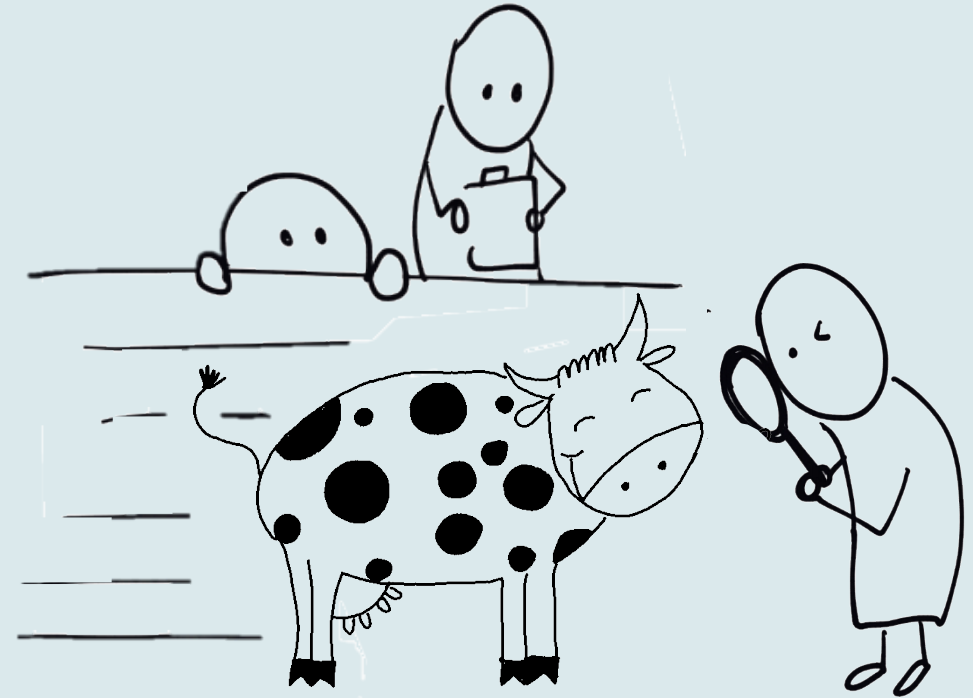
- Increasingly used on commercial farms
- Improvement of herd management

Potential for large scale phenotyping

- Constantly high amounts of data
- Particularly interesting for functional or health traits, for which phenotyping is challenging

Lameness is still a widespread welfare issue on dairy farms

Aim: investigate potential auxiliary traits for lameness based on data from sensor technology!



Farms, animals and data

- **25 Fleckvieh farms** equipped with **LELY** sensor system were motivated to participate in the **D4Dairy** project
- Collar mounted sensors measure **activity, rumination, eating**
- Data collection January 2020 – August 2021

Data

- **Activity:** non-dimensional number
 - **Rumination:** min in 24 hours
 - **Eating:** min in 24 hours
 - **Daily milk yield:** kg from AMS
- } 2 hour intervals
- **Lameness:** scored at test day milkings
 - ➔ By employees of national milk recording organisations
 - ➔ Data were included until 305 days in milk



Trait definition I

Lameness: Locomotion scoring (LSC) 1-5 according to Sprecher et al. (1997)

- **Not lame (0):** $LSC < 3$
- **Lame (1):** $LSC \geq 3$

Activity, rumination time, eating time, and milk yield

- Mean, standard deviation (SD), median (MD) at test day
- Deviation (Δ) between mean and SD at test day and days
 - -10 to -1 and 1 to 10
 - -5 to -1 and 1 to 5
- Regression slopes for the change in mean and SD between days
 - -10 to -1 and 1 to 10
 - -5 to -1 and 1 to 5



Trait definition II

Overall lameness: highest LSC during lactation (305 DIM)

- **Using original scale** LSC 1-5 (not lame – severely lame)
- **Binary:** lame = $LSC \geq 3$, not lame = $LSC < 3$

Activity, rumination time, eating time, and milk yield

- Means of daily mean, SD, MD of sensor variables over 3-305 DIM (first 48 hours after calving were excluded from sensor and AMS data)
- SD of daily means over the lactation period (3-305 DIM)



Bivariate linear animal models lameness and sensor traits

- **Fixed effects:**
 - **Age class** (3 classes in parity 1; 2 classes in parity 2; parities 3, 4, ≥ 5)
 - **Sensor generation** (activity & rumination or eating & rumination)
 - **Days in milk** (covariate; not for whole lactation)
 - **Number of lameness assessments** (covariate, only for lameness and bcs)
- **Random effects**
 - Herd-year-season of calving
 - Genetic effect of the animal
 - Permanent environment
 - Residual



Descriptive statistics

Lameness scorings

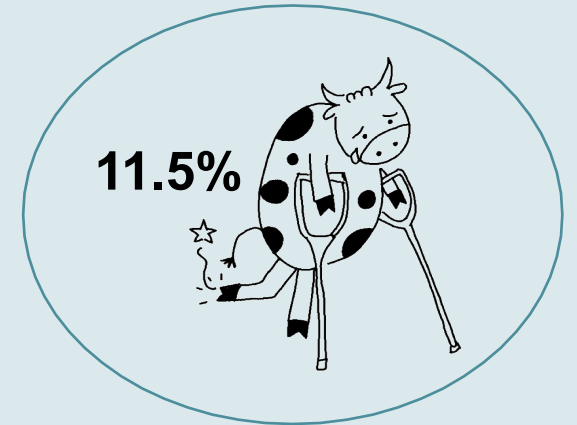
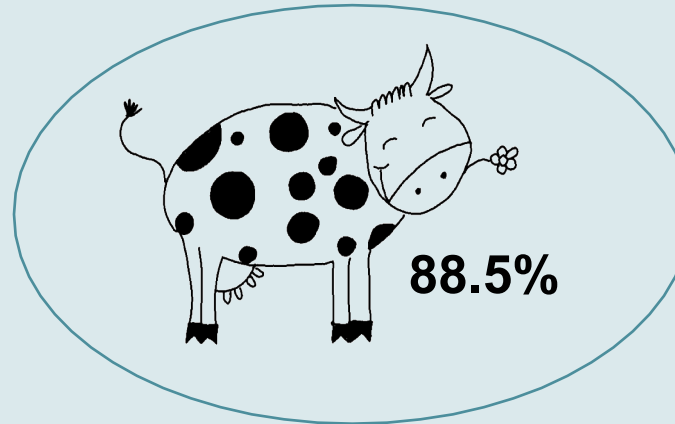
- **18,250** lameness scorings
- **3,258** Fleckvieh cows (max. **2** calvings)
- **63** farms

Including sensor data

- **7,211** lameness scorings
- **1,289** Fleckvieh cows
- **24** farms

Including AMS data

- **15,971** lameness scorings
- **3,001** Fleckvieh cows
- **59** farms



Results I

Heritability for binary lameness trait: $h^2 = 0.10$ (0.02)

Sensor traits - testday	h^2
Activity	0.09 - 0.16 (0.01 - 0.04)
Rumination time	0.03 – 0.30 (0.01 - 0.04)
Eating time	0.11 – 0.33 (0.01 – 0.06)
Milk yield	0.18 (0.03)
BCS	0.38 (0.04)

Genetic correlations were not significantly different from 0 or very low (<0.10)

Results I

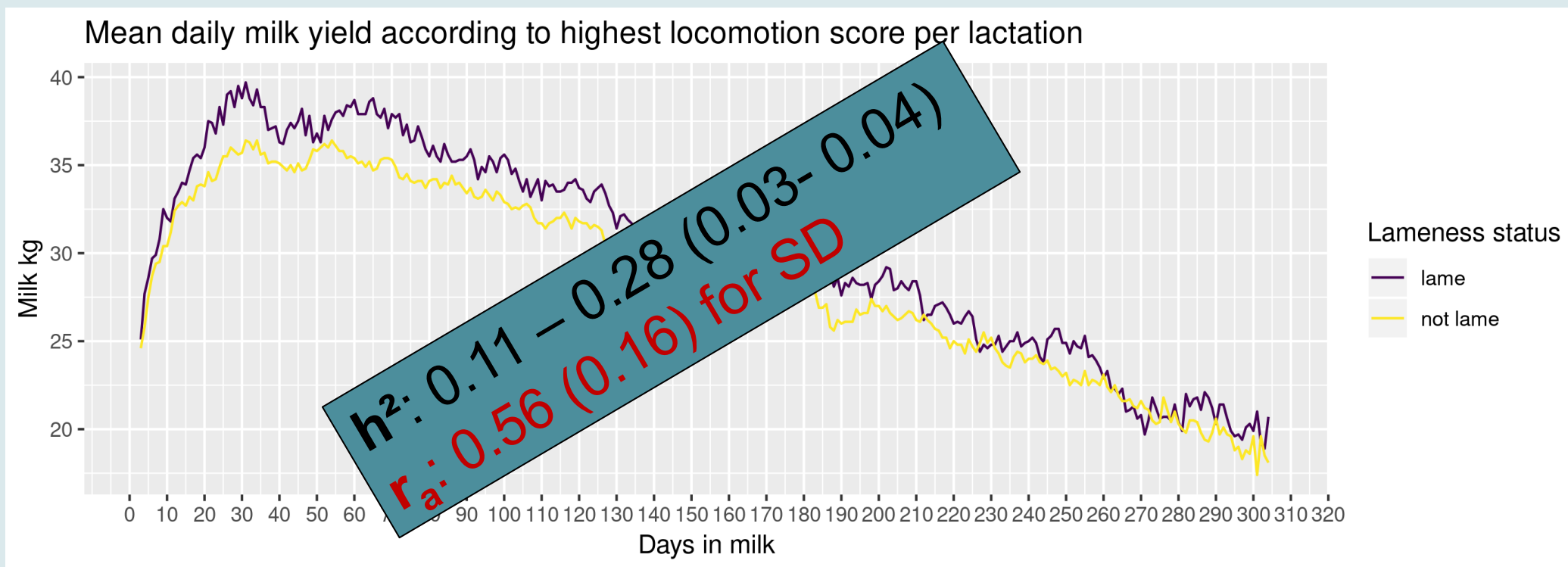
Sensor traits – before	h^2
Activity	0.12 – 0.19 (0.01 – 0.05)
Rumination time	0.10 – 0.37 (0.01 – 0.05)
Eating time	0.20 – 0.37 (0.03 – 0.07)
Milk yield	0.04 – 0.30 (0.01 – 0.02)

Sensor traits – after	h^2
Activity	0.16 – 0.23 (0.04 – 0.06)
Rumination time	0.10 – 0.33 (0.03 – 0.04)
Eating time	0.25 – 0.44 (0.01 – 0.06)

- **Genetic correlations** were not significantly different from 0 or very low
- **Slope traits** did neither show meaningful heritabilities nor genetic correlation with lameness

Sensor variables whole lactation

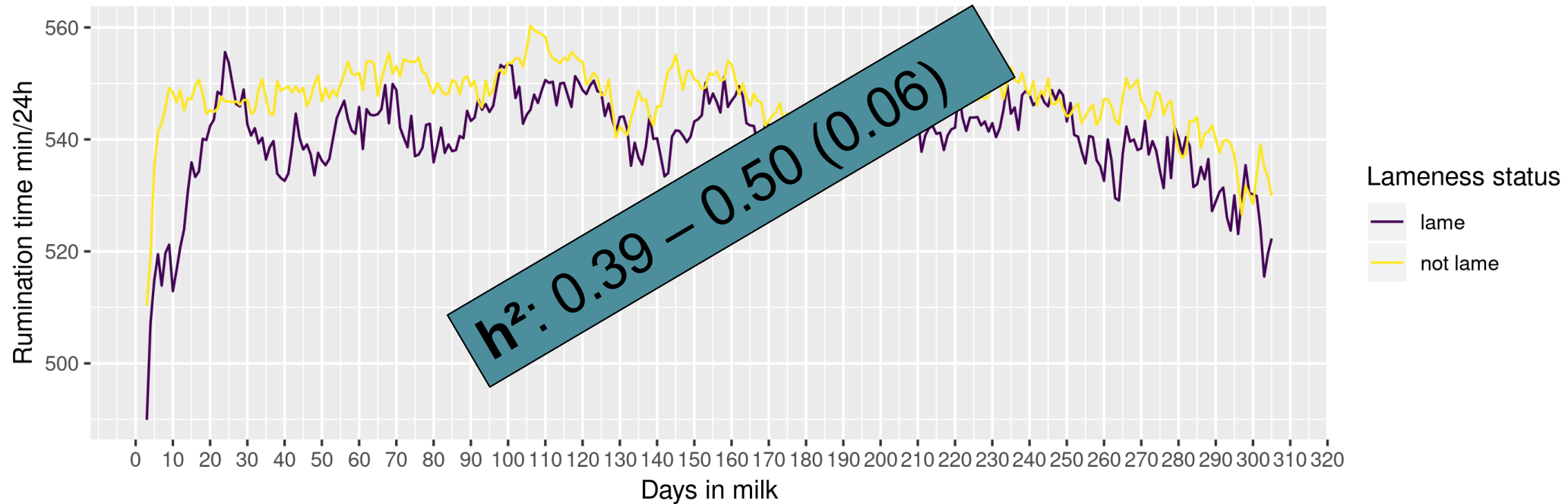
Sensor variable	Overall mean
Milk yield	29.3 (± 9.13) kg



Sensor variables whole lactation

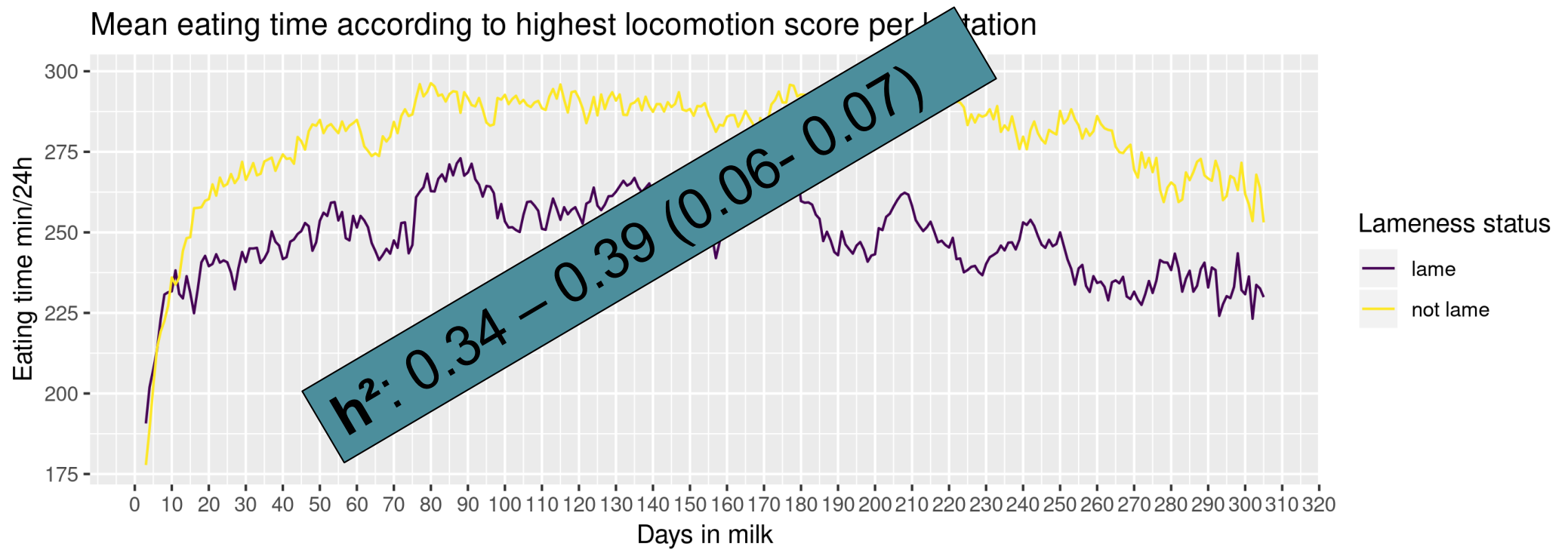
Sensor variable	Overall mean
Rumination time	545 (± 64.5) min/24h

Mean rumination time according to highest locomotion score per lactation



Sensor variables whole lactation

Sensor variable	Overall mean
Eating time	272 (± 75.2) min/24h

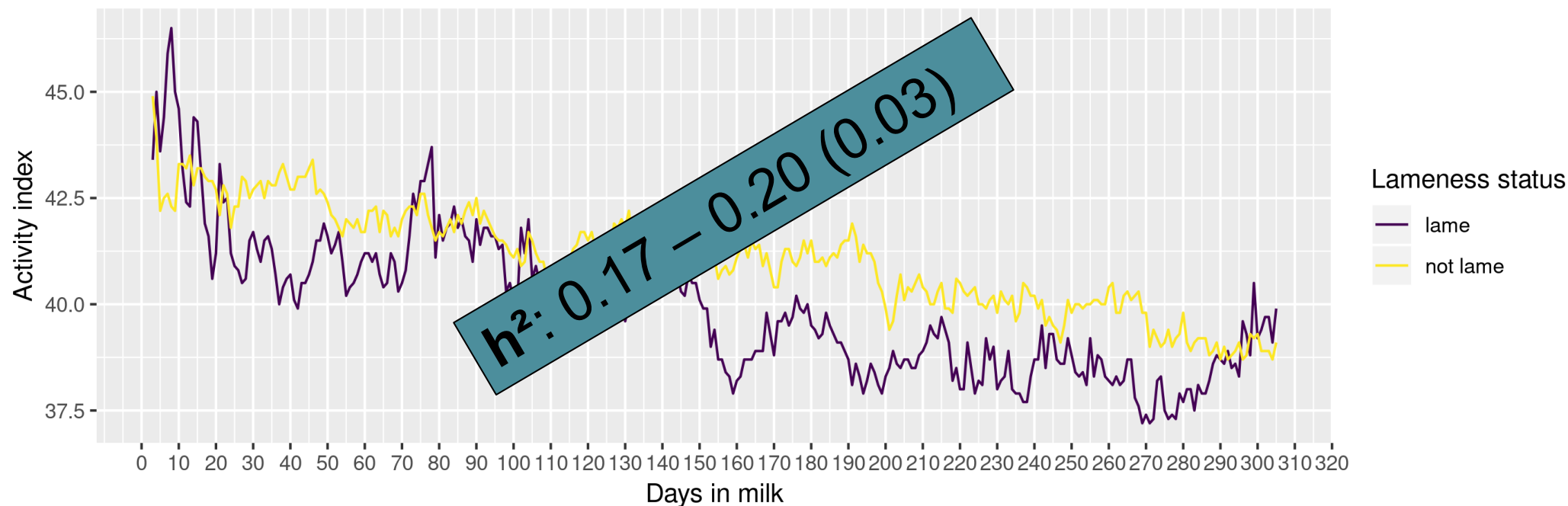




Sensor variables whole lactation

Sensor variable	Overall mean
Activity	41.5 (± 9.47)

Mean activity index according to highest locomotion score per lactation



Discussion & conclusions

- Heritability for **lameness based on LSC** similar to other studies
- **Sensor traits** are heritable and can be used for breeding purposes
 - Higher h^2 for longer periods (testday vs. ± 10 days vs. lactation)
 - Influence on animal welfare and behaviour?
 - Correlations with other traits in the TMI
- **Genetic correlations**
 - None for days before or after lameness scoring
 - ➔ Lameness scoring $\neq$ onset of lameness
 - Higher **deviations in daily milk yield** associated with higher LSC
 - ➔ Single trait available at the end of the lactation!



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**ZUCHT
DATA** 



Thank you for your attention!



D4Dairy

BitKuh

