Genetic variation and consistency among feed efficiency traits in Holstein and Jersey cows

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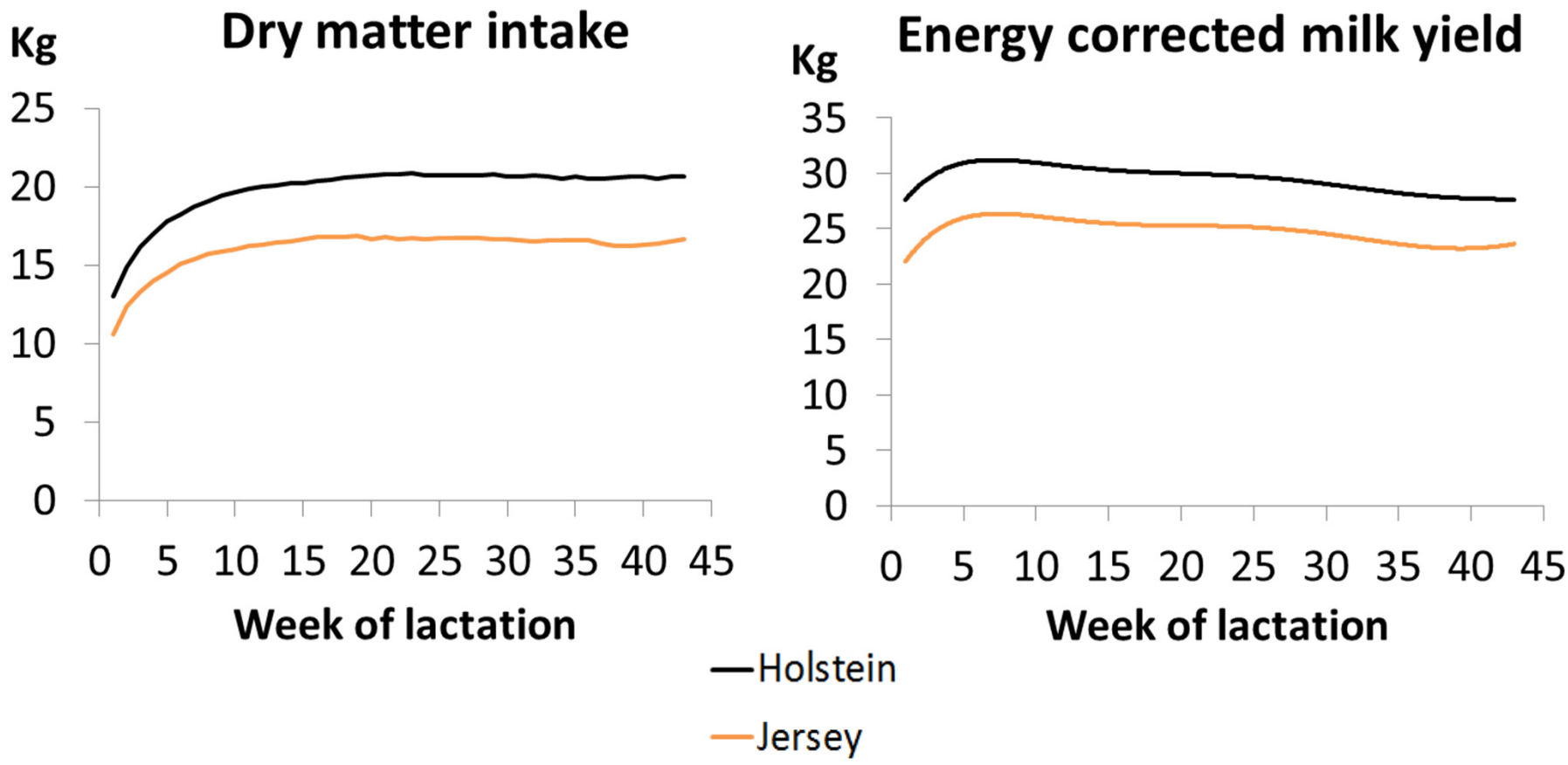
Feed efficiency

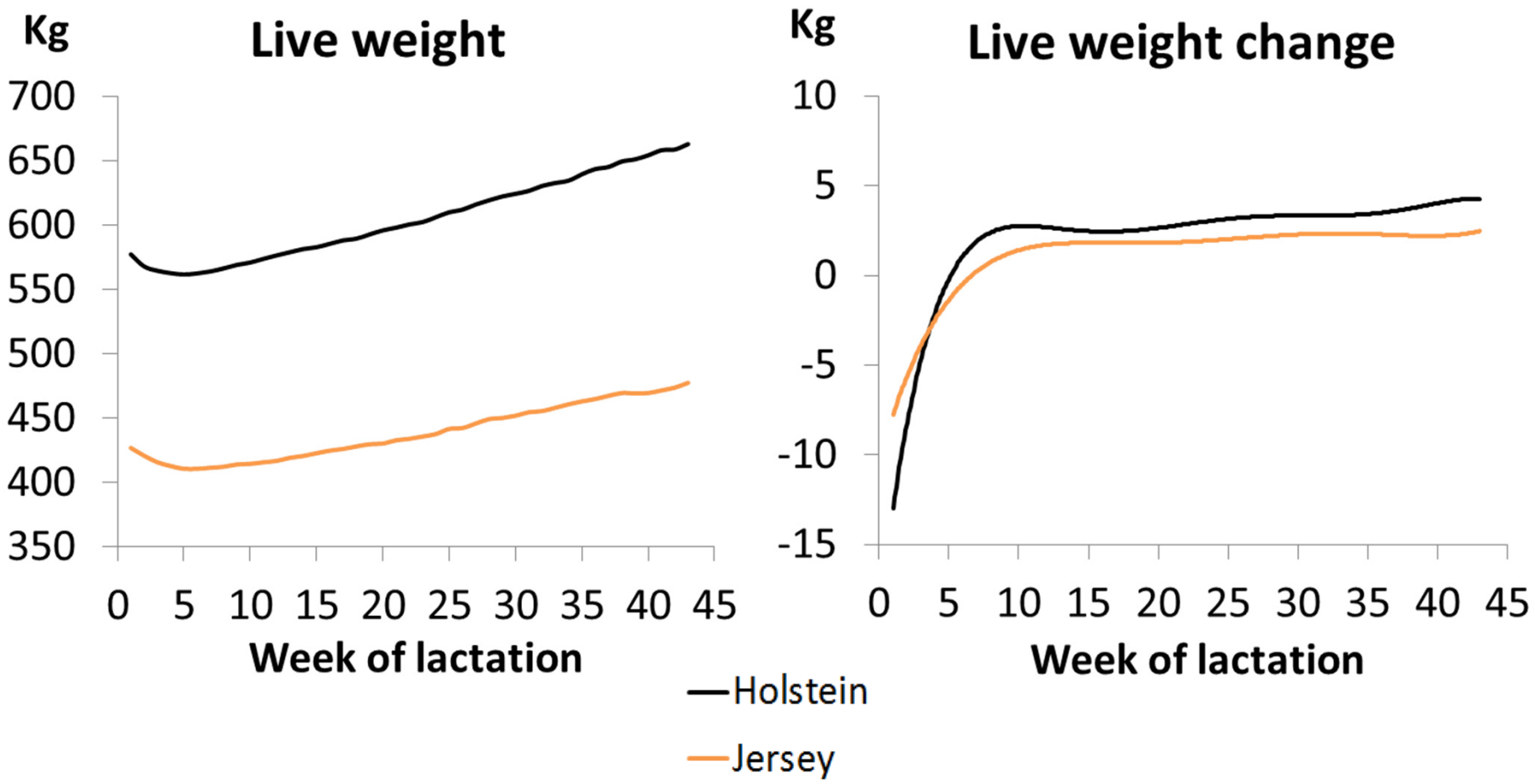
- Importance
  - Feeding costs
  - Environment

- Difficulties
  - Recording feed efficiency traits

Holstein vs. Jersey cows

- Size/weight
- Milk production
- Intake capacity


Dry matter intake
Kg
25
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45
Week of lactation
Energy corrected milk yield
Kg
35
30
25
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45
Week of lactation
Holstein
Jersey


Kg
Live weight
700
650
600
550
500
450
400
350
0 5 10 15 20 25 30 35 40 45
Week of lactation
Kg
Live weight change
10
5
0
-5
-10
-15
0 5 10 15 20 25 30 35 40 45
Week of lactation
Holstein
Jersey

Aims

- Do genetic parameters of feed efficiency traits differ between breeds?
- Do these parameters change throughout lactation?

Materials and methods

- Danish Cattle Research Centre
- 518 first parity Holstein and 264 Jersey cows
- Weekly records from weeks 1-40 of lactation
  - Dry matter intake (DMI)
  - Energy corrected milk yield (ECM)
  - Live weight (LW)
    - Metabolic body weight (MBW) = $LW^{0.75}$
- Lactation divided in ten four week periods

Model

- Within period model:

$$
\begin{aligned}
DMI &= \mu \\
&+ week \\
&+ year \\
&+ season \\
&+ management \\
&+ animal \\
&+ permanent\ environment \\
&+ residual
\end{aligned}
$$

Model

- Within period model:

$$
\begin{aligned}
DMI &= \mu \\
&+ \textbf{week} \\
&+ \textbf{year} \\
&+ \textbf{season} \\
&+ \textbf{management} \\
&+ \text{animal} \\
&+ \text{permanent environment} \\
&+ \text{residual}
\end{aligned}
$$

Model

- Within period model:

$$
\begin{aligned}
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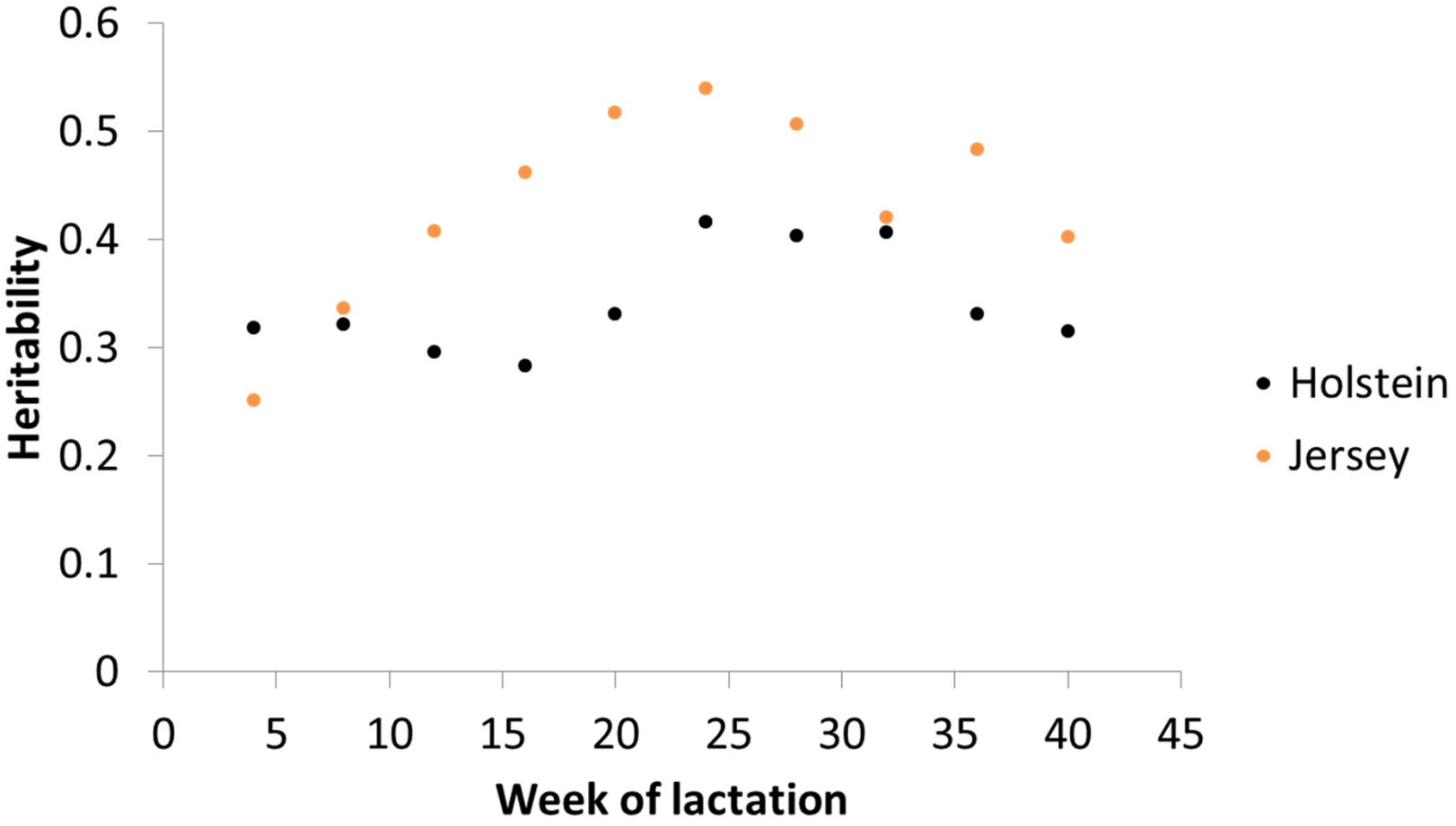
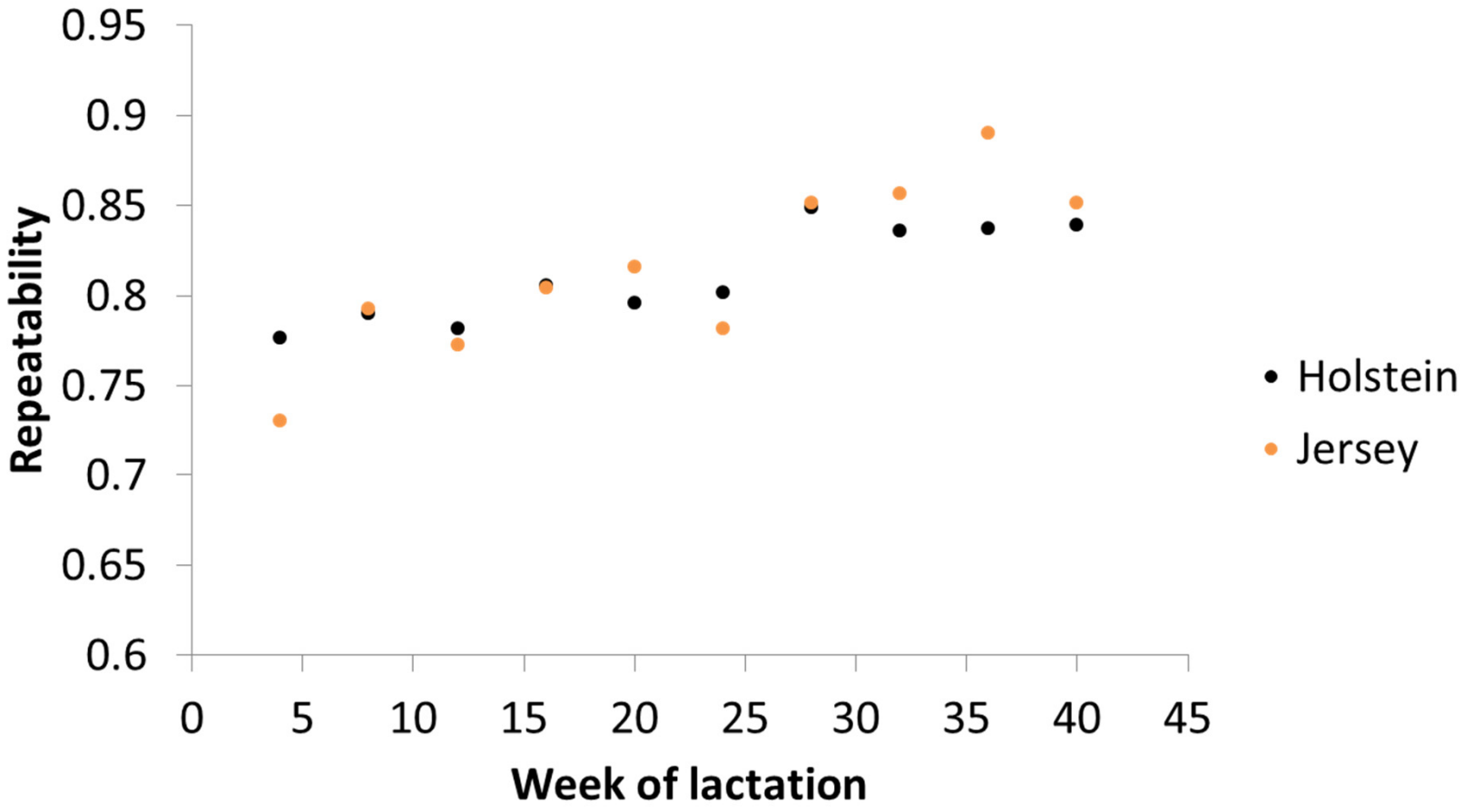
&+ management \\
&+ \textbf{animal} \\
&+ \textbf{permanent environment} \\
&+ \textbf{residual}
\end{aligned}
$$

Dry matter intake - heritability



Dry matter intake - repeatability



Genetic correlations

- Bivariate model (DMI, ECM, MBW)

$$
\begin{aligned}
Y &= \mu \\
&+ \text{week} \\
&+ \text{year} \\
&+ \text{season} \\
&+ \text{management} \\
&+ \text{animal} \\
&+ \text{permanent environment} \\
&+ \text{residual}
\end{aligned}
$$

Genetic correlations

		DMI	ECM	MBW
Holstein	**DMI**	0.28	0.75	0.48
	ECM		0.31	0.00
	MBW			0.47
Jersey	**DMI**	0.33	0.91	0.45
	ECM		0.38	-0.14
	MBW			0.36

Adjusted feed intake

$$
\begin{aligned}
DMI &= \mu \\
&+ week \\
&+ year \\
&+ season \\
&+ management \\
&+ ß_1 \cdot ECM \\
&+ ß_2 \cdot MBW \\
&+ ß_3 \cdot LWchange \\
&+ animal \\
&+ permanent\ environment \\
&+ residual
\end{aligned}
$$

Adjusted feed intake

DMI = μ
+ week
+ year
+ season
+ management
+ **$ß_1 \cdot$ECM**
+ **$ß_2 \cdot$MBW**
+ **$ß_3 \cdot$LWchange**
+ animal
+ permanent environment
+ residual

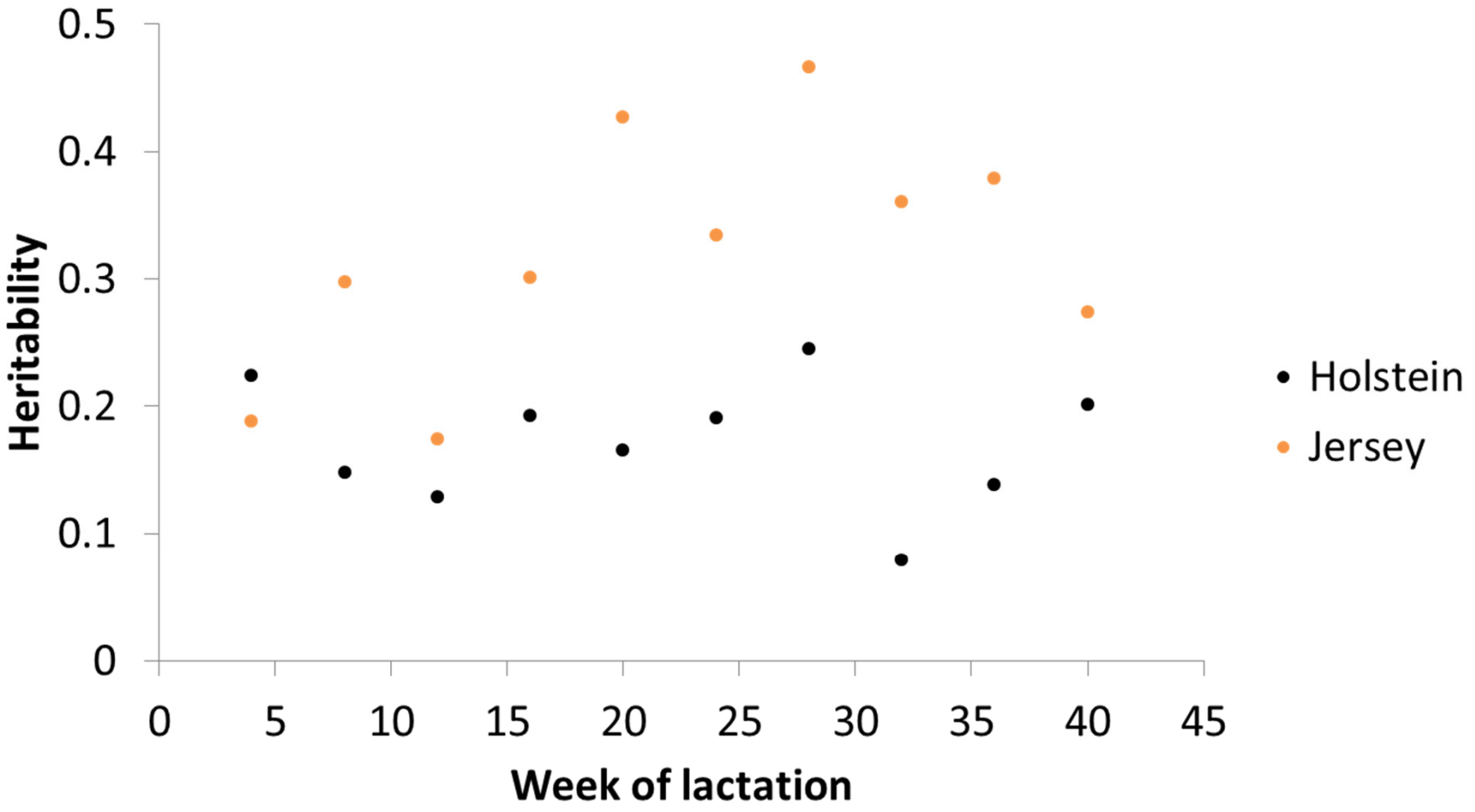
Adjusted feed intake

DMI = μ
+ **week**
+ **year**
+ **season**
+ **management**
+ $ß_1 \cdot ECM$
+ $ß_2 \cdot MBW$
+ $ß_3 \cdot LWchange$
+ animal
+ permanent environment
+ residual

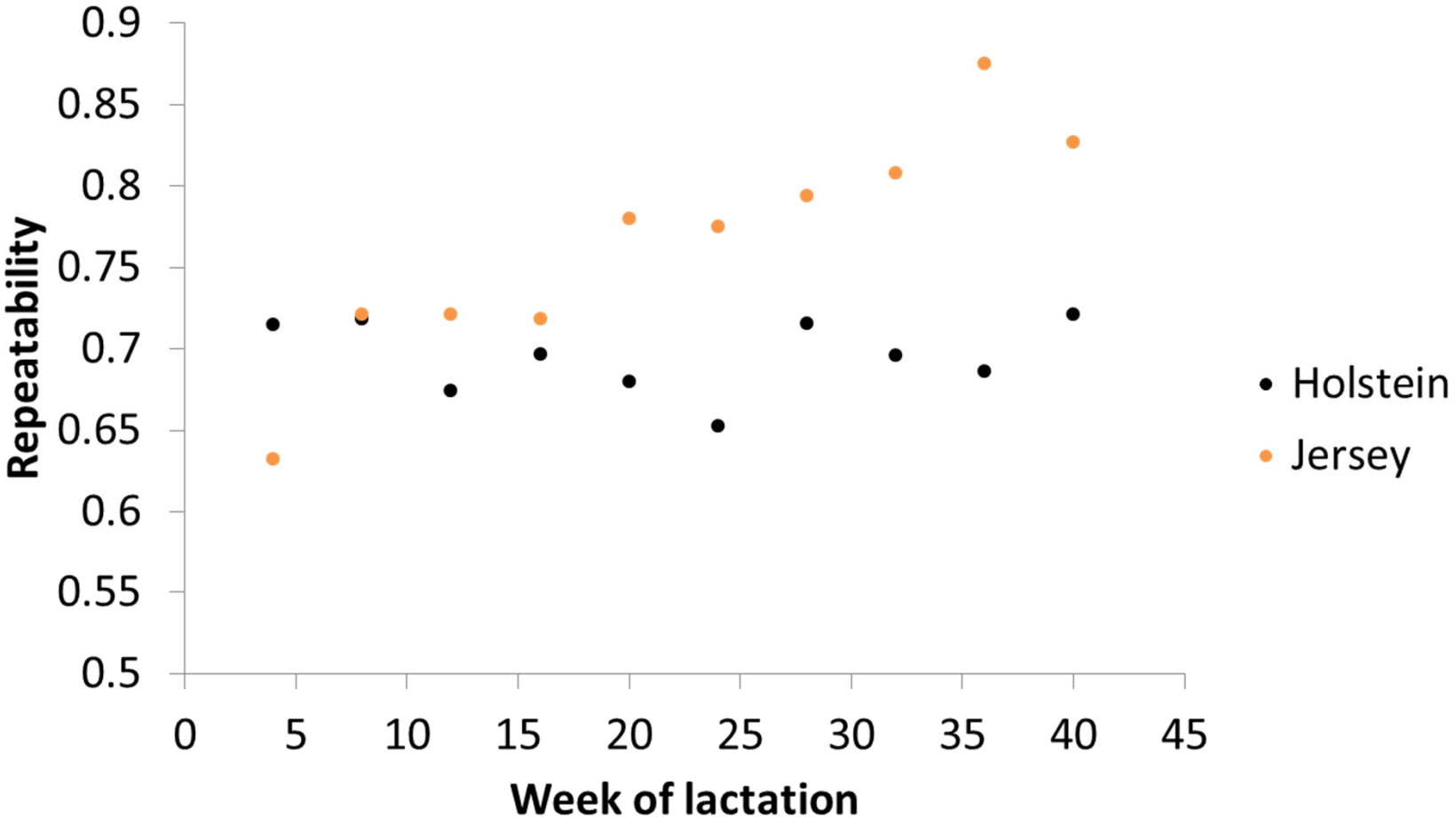
Adjusted feed intake

DMI = μ
+ week
+ year
+ season
+ management
+ $ß_1 \cdot ECM$
+ $ß_2 \cdot MBW$
+ $ß_3 \cdot LWchange$
+ **animal**
+ **permanent environment**
+ **residual**

Adjusted feed intake - heritability



Adjusted feed intake - repeatability



Conclusion

- Dry matter intake and adjusted feed intake are heritable traits
- Genetic parameters do not differ significantly between breeds or throughout lactation