Data from automatic milking systems used in genetic evaluations of temperament and milkability

Karoline Andrea Bakke¹ and Bjørg Heringstad¹,²
¹Department of Animal and Aquacultural Sciences. Norwegian University of Life Sciences. ²Geno Breeding and A. I. Association

EAAP, Warsaw, September 2015
Norwegian dairy farming

• Larger herds with automatic milking systems (AMS)
• >1/3 of the dairy cows are in AMS herds
  \[ \approx 1500 \text{ milking robots} \]
• AMS will be the dominating dairy production system in Norway within a few years
Automatic milking systems (AMS)

- Vast amounts of data are recorded daily
- Objective, frequent and accurate measures of many traits
- How can we best make use of these data?
Aim

• Examine whether data routinely recorded in AMS can be used to define new behavior- and milkability traits
• Estimate genetic correlations between these new traits and the current subjectively scored temperament, milking speed, and leakage
AMS data

- 46 herds with DeLaval milking robots
- Minimum 2 years of data from each herd
- Information from >6000 cows and >2 mill daily records

- Data for genetic analyses
  - Records from 6 to 305 days after calving
  - Lactation 1-7
  - Norwegian Red A.I. sire
Milkability

**MILKABILITY** = Milk yield per total time spent in the milking robot; kg milk per minute “box time”

Box time = actual milking time
  + time used for preparation and attachment of teat cups
  + the time the cow uses before she decide to leave the robot

- A combined measure of milking speed / milk flow and how efficient the cow is when visiting the milking unit
- Directly associated with the capacity of the milking robot
- Lactation mean milkability from day 6 to 305
Distribution of milk yield per minute spent in the milking robot

Overall mean: 1.5 kg milk per minute box time

95 % were within the interval 0.7 – 3.3.
Behavior traits

• Proportion of milkings with “kick-offs” during a lactation (pKO)
• Proportion of incomplete milkings during a lactation (pIC)
Subjectively scored traits

Temperament, milking speed and leakage

– 1st lactation cows
– Data from 330 000 cows
– Scored routinely by dairy farmers
– 3 categories
Model

• Multi-variate linear animal models
  – 3 AMS traits
  – 3 subjectively scored traits
• Variance components estimated using DMU (Madsen & Jensen. 2007)
Heritability and genetic correlations

AMS traits

<table>
<thead>
<tr>
<th>Trait</th>
<th>Milkability</th>
<th>pKO</th>
<th>pIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkability</td>
<td>0.29</td>
<td>-0.35</td>
<td>-0.23</td>
</tr>
<tr>
<td>Proportion KickOffs (pKO)</td>
<td>0.20</td>
<td>0.88</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Subjectively scored traits

<table>
<thead>
<tr>
<th>Trait</th>
<th>Temperament</th>
<th>Milking speed</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperament</td>
<td>0.10</td>
<td>0.16</td>
<td>-0.11</td>
</tr>
<tr>
<td>Milking speed</td>
<td>0.26</td>
<td>-0.84</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Low score is favorable for all traits except milkability. Correlations marked Favorable or Unfavorable.
Genetic correlations between AMS- and subjectively scored traits

<table>
<thead>
<tr>
<th>AMS traits</th>
<th>Subjectively scored traits</th>
<th>Temperament</th>
<th>Milking speed</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkability proportion KickOffs</td>
<td>-0.22 0.09</td>
<td>-0.88 0.03</td>
<td>0.53 0.07</td>
<td></td>
</tr>
<tr>
<td>proportion KickOffs</td>
<td>0.54 0.11</td>
<td>0.27 0.11</td>
<td>0.02 0.13</td>
<td></td>
</tr>
<tr>
<td>proportion Incomplete</td>
<td>0.27 0.18</td>
<td>0.08 0.18</td>
<td>-0.12 0.20</td>
<td></td>
</tr>
</tbody>
</table>

Low score is favorable for all traits except milkability. Correlations marked:

- favorable
- unfavorable
## Genetic correlations between AMS- and subjectively scored traits

<table>
<thead>
<tr>
<th>AMS traits</th>
<th>Subjectively scored traits</th>
<th>Temperament</th>
<th>Milking speed</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkability proportion</td>
<td>-0.22 0.09</td>
<td>-0.88 0.03</td>
<td>0.53 0.07</td>
<td></td>
</tr>
<tr>
<td>KickOffs</td>
<td>0.54 0.11</td>
<td>0.27 0.11</td>
<td>0.02 0.13</td>
<td></td>
</tr>
<tr>
<td>proportion Incomplete</td>
<td>0.27 0.18</td>
<td>0.08 0.18</td>
<td>-0.12 0.20</td>
<td></td>
</tr>
</tbody>
</table>

Low score is favorable for all traits except milkability. Correlations marked:

- Favorable
- Unfavorable

Similar traits genetically
Genetic correlations between AMS- and subjectively scored traits

<table>
<thead>
<tr>
<th>AMS traits</th>
<th>Subjectively scored traits</th>
<th>Temperament</th>
<th>Milking speed</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkability proportion</td>
<td>-0.22 0.09</td>
<td><strong>-0.88 0.03</strong></td>
<td>0.53 0.07</td>
<td></td>
</tr>
<tr>
<td>KickOffs proportion</td>
<td><strong>0.54 0.11</strong></td>
<td>0.27 0.11</td>
<td>0.02 0.13</td>
<td></td>
</tr>
<tr>
<td>proportion Incomplete</td>
<td>0.27 0.18</td>
<td>0.08 0.18</td>
<td><strong>-0.12 0.20</strong></td>
<td></td>
</tr>
</tbody>
</table>

Low score is favorable for all traits except milkability. Correlations marked:
- **favorable**
- unfavorable

→ Similar traits genetically
→ Potential traits to consider as alternative measures of temperament
### Genetic correlations between AMS- and subjectively scored traits

#### Subjectively scored traits

<table>
<thead>
<tr>
<th>AMS traits</th>
<th>Temperament</th>
<th>Milking speed</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkability</td>
<td>-0.22 0.09</td>
<td>-0.88 0.03</td>
<td>0.53 0.07</td>
</tr>
<tr>
<td>proportion KickOffs</td>
<td>0.54 0.11</td>
<td>0.27 0.11</td>
<td>0.02 0.13</td>
</tr>
<tr>
<td>proportionIncomplete</td>
<td>0.27 0.18</td>
<td>0.08 0.18</td>
<td>-0.12 0.20</td>
</tr>
</tbody>
</table>

**Low score is favorable for all traits except milkability. Correlations marked:**

- **favorable**
- **unfavorable**

**Similar traits genetically**

**Potential traits to consider as alternative measures of temperament**

**Genetic association between difficult temperament and slower milking**
### Genetic correlations between AMS- and subjectively scored traits

<table>
<thead>
<tr>
<th>AMS traits</th>
<th>Temperament</th>
<th>Milking speed</th>
<th>Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkability proportion</td>
<td>-0.22 0.09</td>
<td>-0.88 0.03</td>
<td>0.53 0.07</td>
</tr>
<tr>
<td>KickOffs proportion</td>
<td>0.54 0.11</td>
<td>0.27 0.11</td>
<td>0.02 0.13</td>
</tr>
<tr>
<td>Incomplete proportion</td>
<td>0.27 0.18</td>
<td>0.08 0.18</td>
<td>-0.12 0.20</td>
</tr>
</tbody>
</table>

- Low score is favorable for all traits except milkability. Correlations marked:
  - Favorable
  - Unfavorable

- Similar traits genetically
- Potential traits to consider as alternative measures of temperament
- Genetic association between difficult temperament and slower milking
- Unfavorable but not as strong as to subjectively scored milking speed (0.84)
Genetic correlations between AMS- and subjectively scored traits

<table>
<thead>
<tr>
<th>AMS traits</th>
<th>Subjectively scored traits</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temperament</td>
<td>Milking speed</td>
<td>Leakage</td>
<td></td>
</tr>
<tr>
<td>Milkability</td>
<td>-0.22 ± 0.09</td>
<td>-0.88 ± 0.03</td>
<td>0.53 ± 0.07</td>
<td></td>
</tr>
<tr>
<td>proportion KickOffs</td>
<td>0.54 ± 0.11</td>
<td>0.27 ± 0.11</td>
<td>0.02 ± 0.13</td>
<td></td>
</tr>
<tr>
<td>proportion Incomplete</td>
<td>0.27 ± 0.18</td>
<td>0.08 ± 0.18</td>
<td>-0.12 ± 0.20</td>
<td></td>
</tr>
</tbody>
</table>

Low score is favorable for all traits except milkability. Correlations marked:

- **favorable**
- **unfavorable**

- **Similar traits genetically**
- **Potential traits to consider as alternative measures of temperament**
- **Genetic association between difficult temperament and slower milking**
- **Unfavorable but not as strong as to subjectively scored milking speed (0.84)**
New traits

• The cow meet different challenges in the AMS herds
• The breeding program should be adjusted accordingly with respect to traits, trait definitions and weights in the total merit index
• Measures related to milking and cow traffic recorded in AMS that can be used to define new behavior- and milking efficiency traits
• Genetic improvement of such new trait would be beneficial also in other production systems
Conclusion

• Data from AMS can be used for genetic evaluations

• Data routinely recorded in AMS provide information on new traits that can supplement or replace current traits in genetic evaluation
Avler for bære liv