A review of the development of some novel dairy cattle traits based on modern techniques in North America

Albert De Vries

Department of Animal Sciences
University of Florida
Gainesville, Florida, USA
devries@ufl.edu

69th Annual meeting EAAP, Dubrovnik, Croatia, August 27-31, 2018
Session 24. Novel traits (health/quality related traits) based on images or sensors

Overview

- Traits currently used in sales of genetics in USA
- Sensors and image analysis at the 2018 ADSA meeting
- Facial biometrics
- Calves
- Data integration and decision making

Traits routinely evaluated in the USA (USDA/CDCB)

Year	Trait
1926	Milk & fat yields
1978	Conformation (type)
1978	Protein yield
1994	Productive life
1994	SCS (udder health)
2000	Calving ease (dystocia)[1]
2003	Daughter pregnancy rate
2006	Stillbirth rate
2006	Bull conception rate[2]
2009	Cow & heifer conception rates
2016	Cow livability
2017	Gestation length
2017	Residual feed intake (research)[3]
2018	Disease resistance (6 traits)[4]

[1]Sire calving ease evaluated by Iowa State University (1978–99)

[2]Estimated relative conception rate evaluated by DRMS in Raleigh, NC (1986–2005)

[3]Research trait … no official evaluations yet

[4]Official evaluations launched April 2018

Disease resistance ➔ Health trait index

Disease	Estimated direct cost*
Hypocalcemia	$38
Displaced abomasum	$178
Ketosis	$28
Mastitis	$72
Metritis	$105
Retained placenta	$64

Diagnosis of diseases increasingly more supported by sensors

*Liang et al., 2017; Donnelly et al. (2016).

Example: Other traits offered in North America

CLARIFIDE® PLUS… PROVIDES MORE OPPORTUNITY FOR COW AND CALF WELLNESS AND PROFIT

CDCB Evaluation

- Parentage
- **Production**
- **Fertility**
- **Longevity, Milk Quality & Calving**
- **Functional Type**

Wellness Traits

- **Mastitis**
- **Lameness**
- **Metritis**
- **Retained Placenta**
- **Displaced Abomasum**
- **Ketosis**

Calf Wellness

- **Calf Livability**
- **Calf Respiratory**
- **Calf Scours**

Genetic Conditions

- **Polled (no fee)**
- Milk Components
- Genetic conditions*
- Infertility Haplotypes

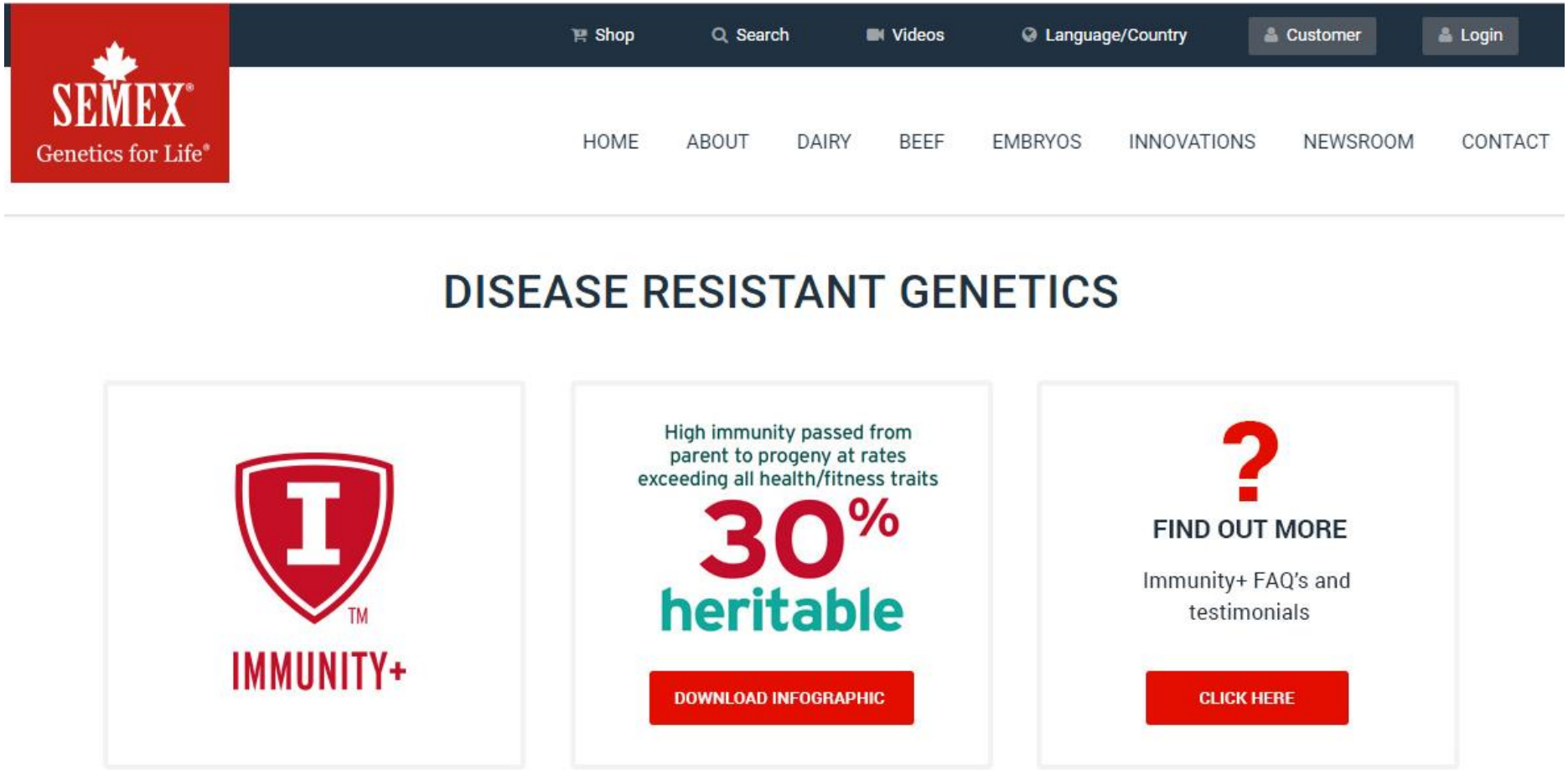
* CVM, Brachyspina and Beta Casein A2 available with add-on fee.

DWP$® Animal Ranking

CLARIFIDE plus

zoetis

Example: Other traits offered in North America



Example: Other traits offered in North America

Direction: Robot data used for genetic evaluations

Novel traits with heritability estimates

Egger-Danner et al. Animal 9:191 (2015). Table 2

Udder health

- Clinical mastitis, improved SCC, electrical conductivity, pathogen information, lactoferrin, minerals, near-IR spectroscopy, PCR, IR thermography

Reproduction

- Fertility related diseases, lutheal activity, multiple ovulation, ovary cycle health

Metabolism

- Ketosis, milk fever, displaced abomasum, fat/protein ratio

Feed and legs

- Lameness, disorders based on veterinary or hoof trim data

Feed efficiency and methane

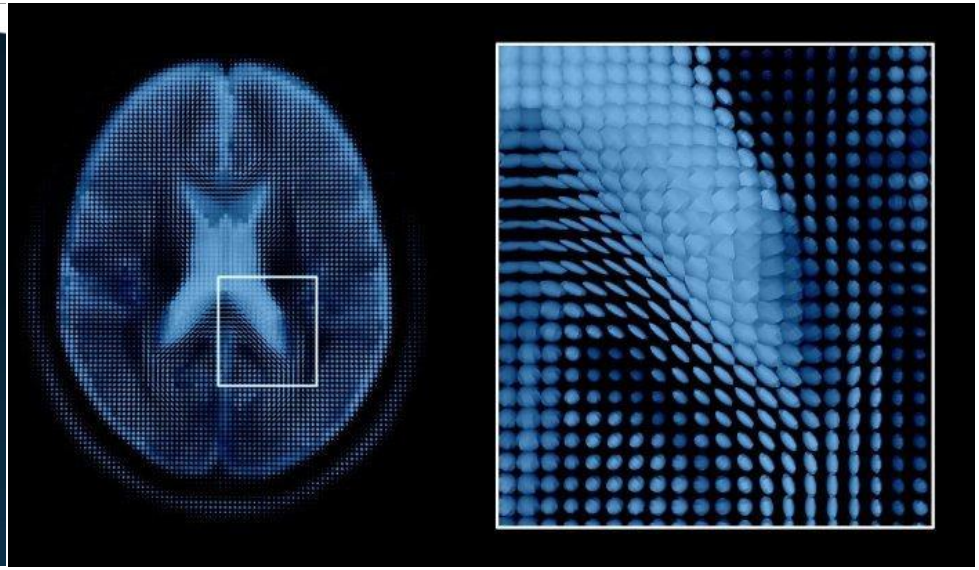
- Residual feed intake, methane prediction

Other novel traits

- Temperament, suckling behavior, milkability, AMS behavior traits, activity data, fatty acids

Novel traits based on sensors and image analysis

Slide: Jeffrey Bewley



Picture stolen from internet

Potential for new phenotypic data from automated technology measurements
Jeffrey Bewley. https://www.slideshare.net . Posted May 2018

2018 ADSA annual meeting
Search for "sensor" in abstracts

144 A novel approach to estimate intake of lactating dairy cows through multiple on-cow accelerometer sensors. N. A. Carpinelli*, F. Rosa, R. C. B. Grazziotin, and J. S. Osorio, *Dairy and Food Science Department, South Dakota State University, Brookings, SD.*

145 Validation of an ear-tag accelerometer to identify feeding and activity behaviors of tie-stall housed dairy cattle. A. Zambelis, T. Wolfe, and E. Vasseur*, *Department of Animal Science, McGill University, Ste-Anne-de-Bellevue, QC, Canada.*

T56 Preliminary exploration of the relationship between automated rumen sensor data and feed intake in lactating dairy cows. C. J. Siberski*, M. R. O'Neil, J. E. Koltes, and H. A. Ramirez-Ramirez, *Iowa State University, Ames, IA.*

269 Statistical validation of a geometric approach to image analysis of anatomical traits. C. McVey*[1], J. Velez[2], and P. Pinedo[1], [1]*Colorado State University, Fort Collins, CO,* [2]*Aurora Organic Dairy, Boulder, CO.*

2018 ADSA annual meeting
Search for "sensor" in abstracts (II)

449 The value of precision technologies in the genetic evaluation of dairy cows. M. van der Voort*[1], C. Kamphuis[2], and H. Hogeveen[1], [1]*Wageningen University, Business Economics Group, Wageningen, the Netherlands,* [2]*Wageningen Livestock & Research, Animal Breeding and Genetics Centre, Wageningen, the Netherlands.*

450 Early prediction of lactational milk, fat and protein yields using daily milk data. O. Nir (Markusfeld), G. Katz*, and L. Reuveni, *Afimilk, Kibbutz Afikim, Israel.*

451 Comparison of milk composition and somatic cell count estimates from automatic milking systems sensors and milk recording laboratory analyses. L. Fadul-Pacheco[1,2], R. Lacroix[1], M. Séguin[1], M. Grisé[1], E. Vasseur[2], and D. Lefebvre*[1], [1]*Valacta, Ste-Anne-de-Bellevue, QC, Canada,* [2]*McGill University, Ste-Anne-de-Bellevue, QC, Canada.*

452 Challenges and opportunities for evaluating and using the genetic potential of dairy cattle in the new era of sensor data from automation. N. Gengler*, *ULiege-GxABT, Gembloux, Belgium.*

2018 ADSA annual meeting

Search for "image" in abstracts

M201 Assessment of heat and methane production through infrared thermography in mid-lactation dairy cows. A. R. Guadagnin[1], V. Fischer*[1], J. P. Matiello[1], L. G. R. Pereira[2], and F. S. Machado[2], [1]*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil,* [2]*Empresa Brasileira de Pesquisa Agropecuaria, Juiz de Fora, MG, Brazil.*

M209 Use of 3-dimensional camera to predict body weight in pre-weaned dairy calves. J. R. R. Dorea*, A. F. A. Fernandes, V. C. Ferreira, A. Cominotte, D. K. Combs, and G. J. M. Rosa, *University of Wisconsin-Madison, Madison, WI.*

365 Automatic classification of dairy cattle skin injury type and severity using machine-learning techniques. A. A. Boatswain Jacques[1], R. S. Knight[1], M. Leduc*[2,3], V. I. Adamchuk[1], and E. Vasseur[2], [1]*Bioresource Engineering Department, McGill University, Montreal, PQ, Canada,* [2]*Animal Science Department, McGill University, Montreal, PQ, Canada,* [3]*Valacta, Sainte-Anne-de-Bellevue, PQ, Canada.*

454 Image-based phenotyping: Examples from plant breeding. N. Miller*, *University of Wisconsin, Madison, WI.*

Research Report

aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Psychological Science
22(12) 1478–1483

DOI: 10.1177/0956797611418838
http://pss.sagepub.com
SAGE

A Face Only an Investor Could Love: CEOs' Facial Structure Predicts Their Firms' Financial Performance

Elaine M. Wong[1], Margaret E. Ormiston[2], and Michael P. Haselhuhn[3]

[1]Department of Communication, University of Wisconsin–Milwaukee; [2]Department of Organisational Behaviour, London Business School; and [3]Sheldon B. Lubar School of Business, University of Wisconsin–Milwaukee

PROCEEDINGS OF THE ROYAL SOCIETY B

Proc. R. Soc. B (2008) **275**, 2651–2656
doi:10.1098/rspb.2008.0873
Published online 19 August 2008

In your face: facial metrics predict aggressive behaviour in the laboratory and in varsity and professional hockey players

Justin M. Carré[1] and Cheryl M. McCormick[1,2,*]

[1]Department of Psychology, and [2]Centre for Neuroscience, Brock University, 500 Glenridge Avenue, St Catharines, Ontario, Canada L2S 3A1

Chinese lecturer to use facial-recognition technology to check boredom levels among his students

share

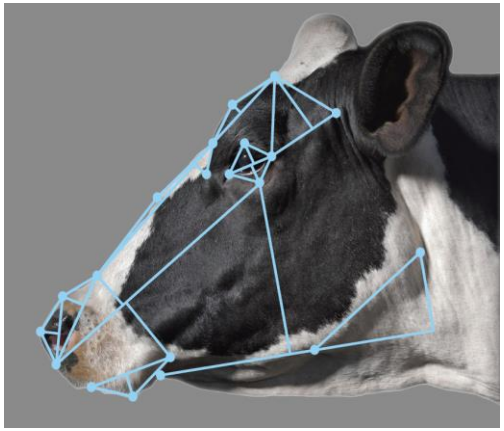
Save

https://www.telegraph.co.uk/news/2016/09/12/facial-recognition-technology-used-in-chinese-classroom-to-check/

Chinese police with facial recognition glasses

356 Facial biometrics as predictors of productivity, fertility, and health traits in elite dairy sires. C. McVey* and P. Pinedo, *Colorado State University, Fort Collins, CO.*

ADSA 2017



1. Pictures from sire catalogue, 62 bulls
2. gEstimated Breeding Values: productivity, health, longevity, fertility
3. Use facial recognition software → facial biometrics
4. Predictors: gPTA type traits + facial biometrics

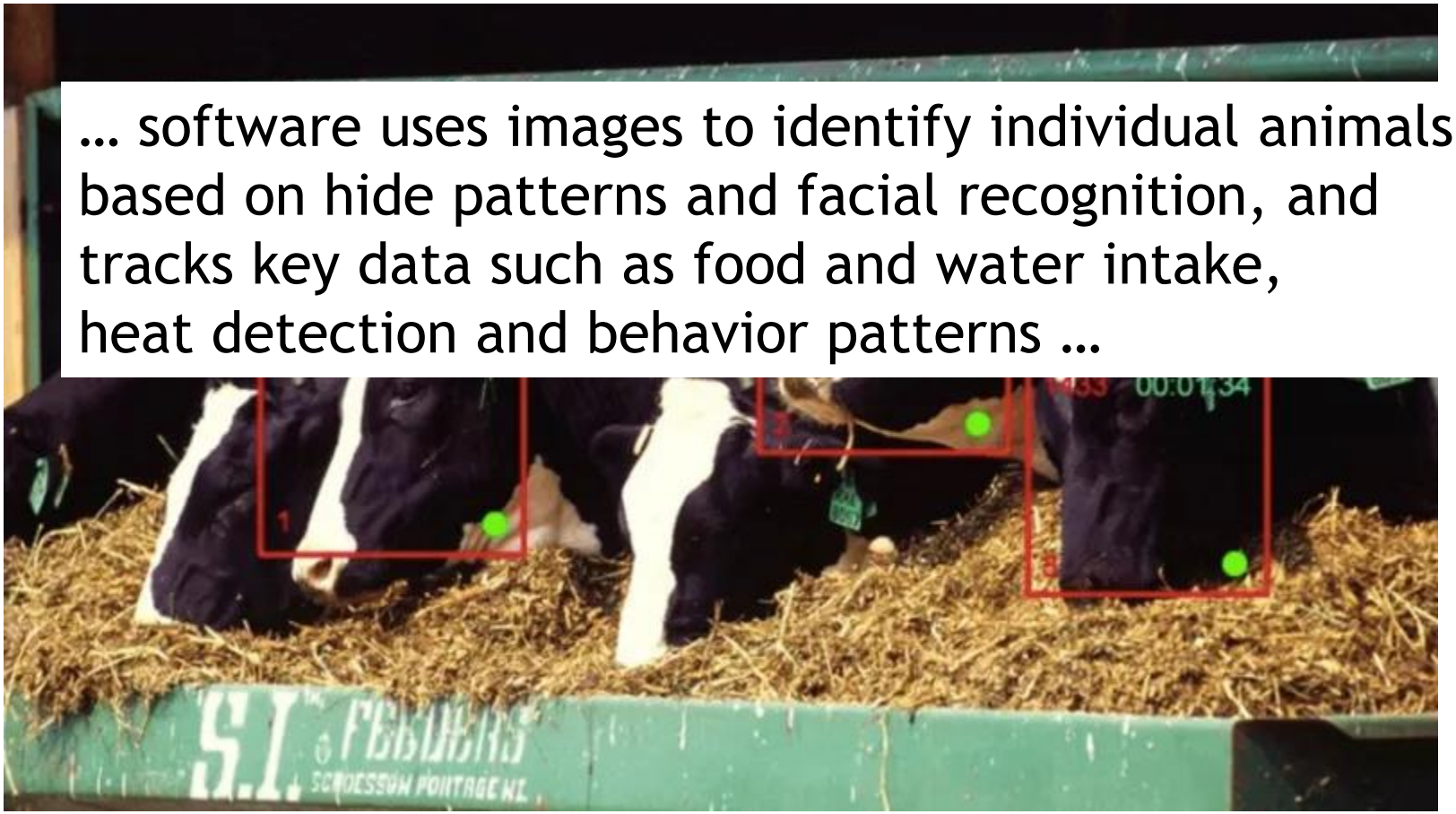
Conclusion:

"All traits demonstrated significant correlations with facial biometrics. Productivity, longevity, and fertility traits were particularly well predicted."

NEWS

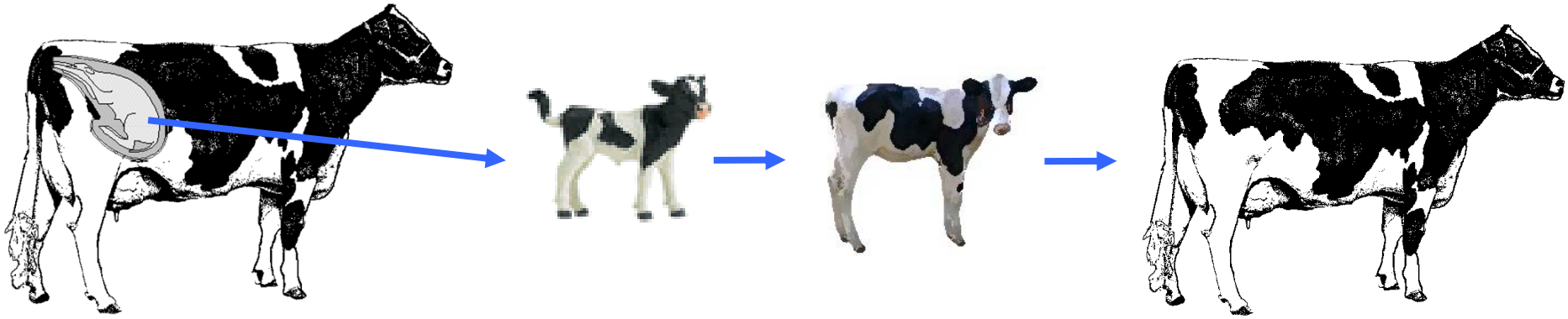
Finally, Facial Recognition for Cows Is Here

Sidney Fussell
2/01/18 10:40am • Filed to: LIVESTOCK IS TECH



https://gizmodo.com/finally-facial-recognition-for-cows-is-here-1822609005

Growing interest in risk factors early in life to predict future performance and health



Genetics
Nutrition
Environment
Health

+

Genetics
Health
Growth
Behavior

→ Cow performance

Automatic calf feeders have arrived in the USA

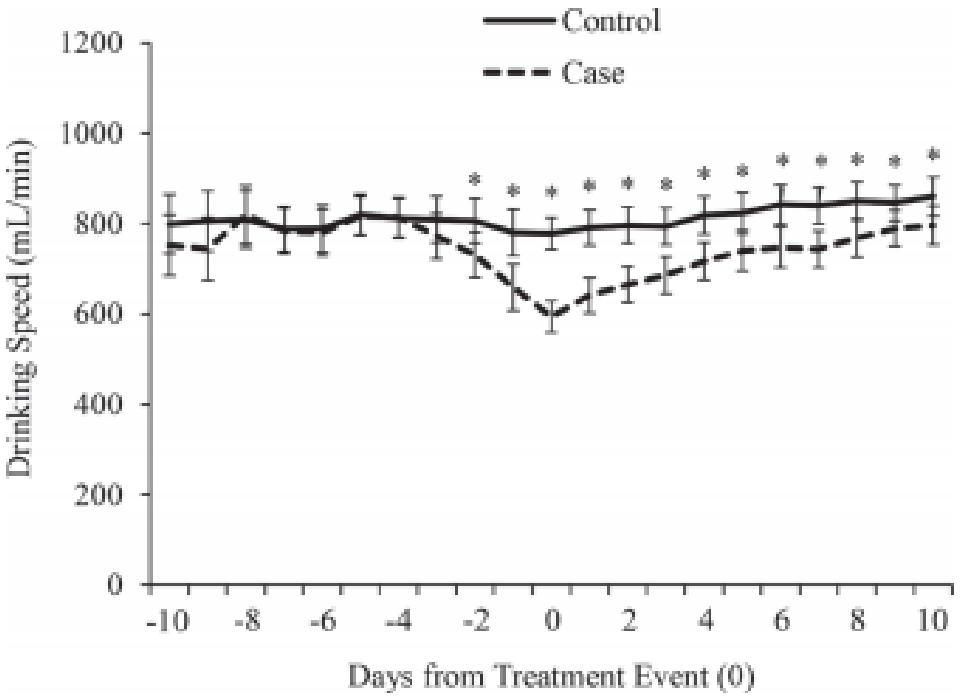
Measure:

- Drinking speed
- Milk consumption
- Visit frequency
- Unrewarded visits

J. Dairy Sci. 100:5642–5652
https://doi.org/10.3168/jds.2016-12372

The association between daily average feeding behaviors and morbidity in automatically fed group-housed preweaned dairy calves

W. A. Knauer,*[1] S. M. Godden,* A. Dietrich,† and R. E. James†
*Department of Veterinary Population Medicine, University of Minnesota, St. Paul 55108
†Department of Dairy Science, The Virginia Polytechnic and State University, Blacksburg 24061



"Sick calves change their feeding behavior before and during an illness event, suggesting that feeding behavior may be a useful tool to detect disease onset."

Calf location tracking

“We have the technology to track animals very precisely, and get data (use of space/resources, social networks) that are likely to be predictive of health, productivity, welfare. However, there isn't a lot of clarity here yet.”

Dr. Emily Miller-Cushion
Animal welfare and behavior
University of Florida

J. Dairy Sci. 101:7437–7449
https://doi.org/10.3168/jds.2017-14248

Personality is associated with feeding behavior and performance in dairy calves

Heather W. Neave, Joao H. C. Costa,[1] Daniel M. Weary, and Marina A. G. von Keyserlingk[2]
Animal Welfare Program, University of British Columbia, 2357 Mall, Vancouver, BC, Canada, V6T 1Z4

3 behaviors (interactive, exploratory-active, and vocal-inactive) explained 73% of the variance in feeding behavior.

DHM: Automatic milk feeding system + careful daily monitoring of the calves by employees ➔ identify health, performance, and personality differences for individual calf management to best meet their needs.

Automatically measure personality, location, activity with video/image analysis?

SCIENTIFIC AMERICAN.

BIOLOGY

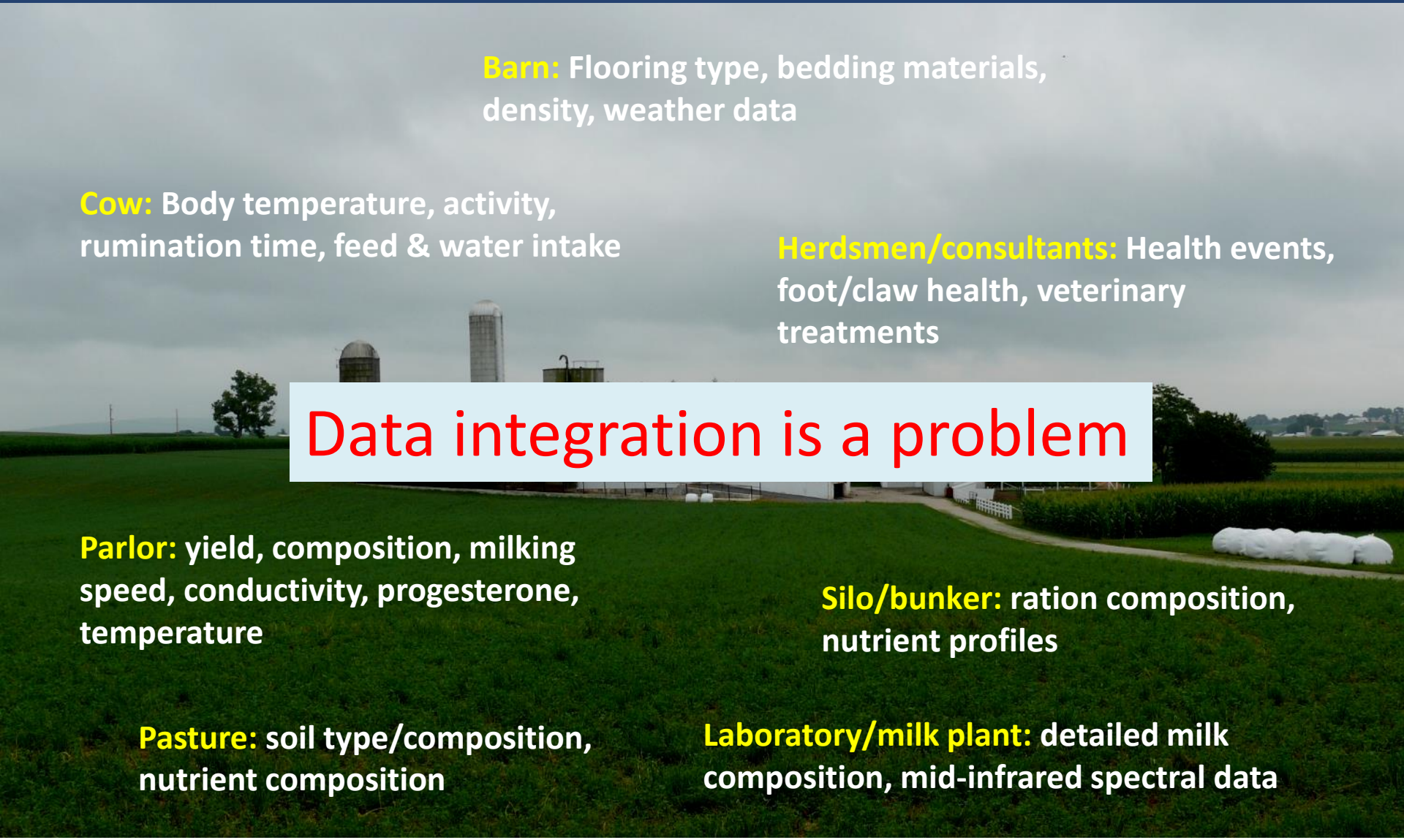
Fowl Language: AI Decodes the Nuances of Chicken "Speech"

How machine learning can translate chicken chatter and improve farming

By Ferris Jabr on December 11, 2017

"… the birds have "patterns of speech" that reveal a lot about their well-being."

Where do new phenotypes come from?



Barn: Flooring type, bedding materials, density, weather data

Cow: Body temperature, activity, rumination time, feed & water intake

Herdsmen/consultants: Health events, foot/claw health, veterinary treatments

Data integration is a problem

Parlor: yield, composition, milking speed, conductivity, progesterone, temperature

Silo/bunker: ration composition, nutrient profiles

Pasture: soil type/composition, nutrient composition

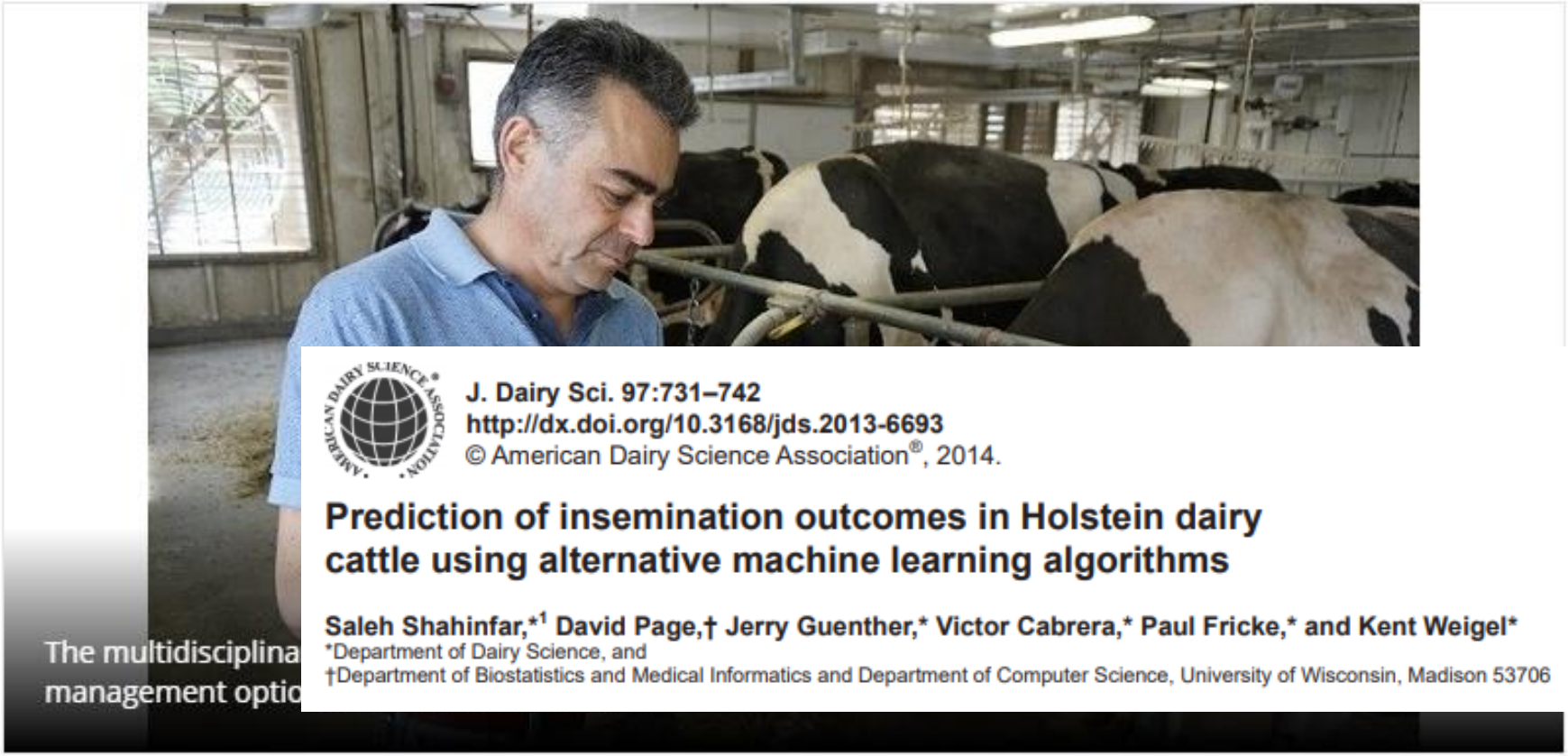
Laboratory/milk plant: detailed milk composition, mid-infrared spectral data

Source: http://commons.wikimedia.org/wiki/File:Amish_dairy_farm_3.jpg

University of Wisconsin virtual dairy farm uses AI to improve farm management

By Mary Ellen Shoup

22-Aug-2017 - Last updated on 23-Aug-2017 at 08:12 GMT



The multidisciplina
management optio

J. Dairy Sci. 97:731–742
http://dx.doi.org/10.3168/jds.2013-6693

Prediction of insemination outcomes in Holstein dairy cattle using alternative machine learning algorithms

Saleh Shahinfar,*[1] David Page,† Jerry Guenther,* Victor Cabrera,* Paul Fricke,* and Kent Weigel*
*Department of Dairy Science, and
†Department of Biostatistics and Medical Informatics and Department of Computer Science, University of Wisconsin, Madison 53706

https://www.dairyreporter.com/Article/2017/08/23/University-of-Wisconsin-starts-virtual-dairy-farm-project-using-AI

Summary

- Most ideas/technologies come from Europe, Asia
- Novel traits: welfare, animal happiness, adaptation
- Trends towards image analysis, artificial intelligence, combining data from various sources
- Data integration likely a problem in the USA

Thank you

devries@ufl.edu